

TM 9-1617

WAR DEPARTMENT TECHNICAL MANUAL

ORDNANCE MAINTENANCE

GENERATING UNIT M18



NOTIFICATION OF RESTRICTED MATTER —

No person is entitled solely by virtue of his grade or position to knowledge or possession of classified matter. Such matter is entrusted only to those individuals whose official duties require such knowledge or possession. (See also paragraph 23b, AR 380-5, 15 March 1944.)

WAR DEPARTMENT • 16 NOVEMBER 1944

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TM 9-1617

This Technical Manual supersedes TB ORD 74 in so far as it applies to TM 9-1617. TB ORD 74 remains in effect until it is incorporated in other affected manuals or specifically rescinded.

ORDNANCE MAINTENANCE

GENERATING
UNIT M18



WAR DEPARTMENT

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WAR DEPARTMENT

Washington 25, D. C., 16 November 1944

TM 9-1617, Ordnance Maintenance: Generating Unit M18, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

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(For explanation of symbols, see FM 21-6.)

CONTENTS

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	Paragraphs	Pages
CHAPTER 1. INTRODUCTION	1- 3	1- 4
CHAPTER 2. BASIC INSPECTION	4- 9	5- 10
CHAPTER 3. GENERAL MAINTENANCE	10- 23	11- 36
SECTION I. Tune-up and periodic maintenance	10- 11	11- 16
II. Trouble shooting	12- 23	17- 36
CHAPTER 4. ENGINE AND ACCESSORIES	24- 78	37-206
SECTION I. Engine (general)	24- 25	37- 42
II. Cooling system	26- 30	42- 55
III. Fuel system	31- 38	56- 91
IV. Exhaust system	39- 43	91- 98
V. Engine lubrication system	44- 47	98-109
VI. Engine electrical system—battery charging generator and regulator; electric brake receptacle	48- 51	109-132
VII. Engine electrical system—ignition	52- 55	133-149
VIII. Engine electrical system—starting motors	56- 57	149-158
IX. Engine removal and disassembly	58- 60	159-175
X. Inspection of disassembled engine	61- 67	175-182
XI. Engine repair	68- 71	183-189
XII. Engine assembly and installation	72- 75	190-205
XIII. Consolidated engine service data	76- 78	205-206

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CONTENTS (Contd.)

	Paragraphs	Pages
CHAPTER 5. A-C GENERATING SYSTEM	79- 90	207-258
SECTION I. A-C generator	79- 87	207-250
II. Power receptacles and load terminal box	88- 90	250-258
CHAPTER 6. INSTRUMENT PANEL	91-121	259-302
SECTION I. Panel	91- 96	259-262
II. Instruments and gages	97-103	262-269
III. Controls and receptacles	104-114	269-287
IV. Voltage regulator	115-121	287-302
CHAPTER 7. RADIO INTERFERENCE SUPPRES- SION	122-126	303-308
CHAPTER 8. FRAME AND HOUSING	127-128	309-311
CHAPTER 9. REFERENCES	129-131	312-314
INDEX		315-320

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CHAPTER 1

INTRODUCTION

1. SCOPE.

a. This Technical Manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, and repair of the Generating Unit M18, supplementary to those in the Field Manuals and Technical Manuals for the using arm. Service operations, such as removal and installation of many accessories which are covered in TM 9-617, are omitted from this manual.

2. CHARACTERISTICS.

a. **General.** The Generating Unit M18 (figs. 1, 2, and 3) is a gasoline-engine-driven generator used to provide electric current for operation of a battery of antiaircraft guns. It is mounted on a welded-steel frame either for use on a specially designed trailer or set upon wooden skids. The radiator end of the unit is considered the front. Right and left sides are determined from the rear, facing toward the radiator.

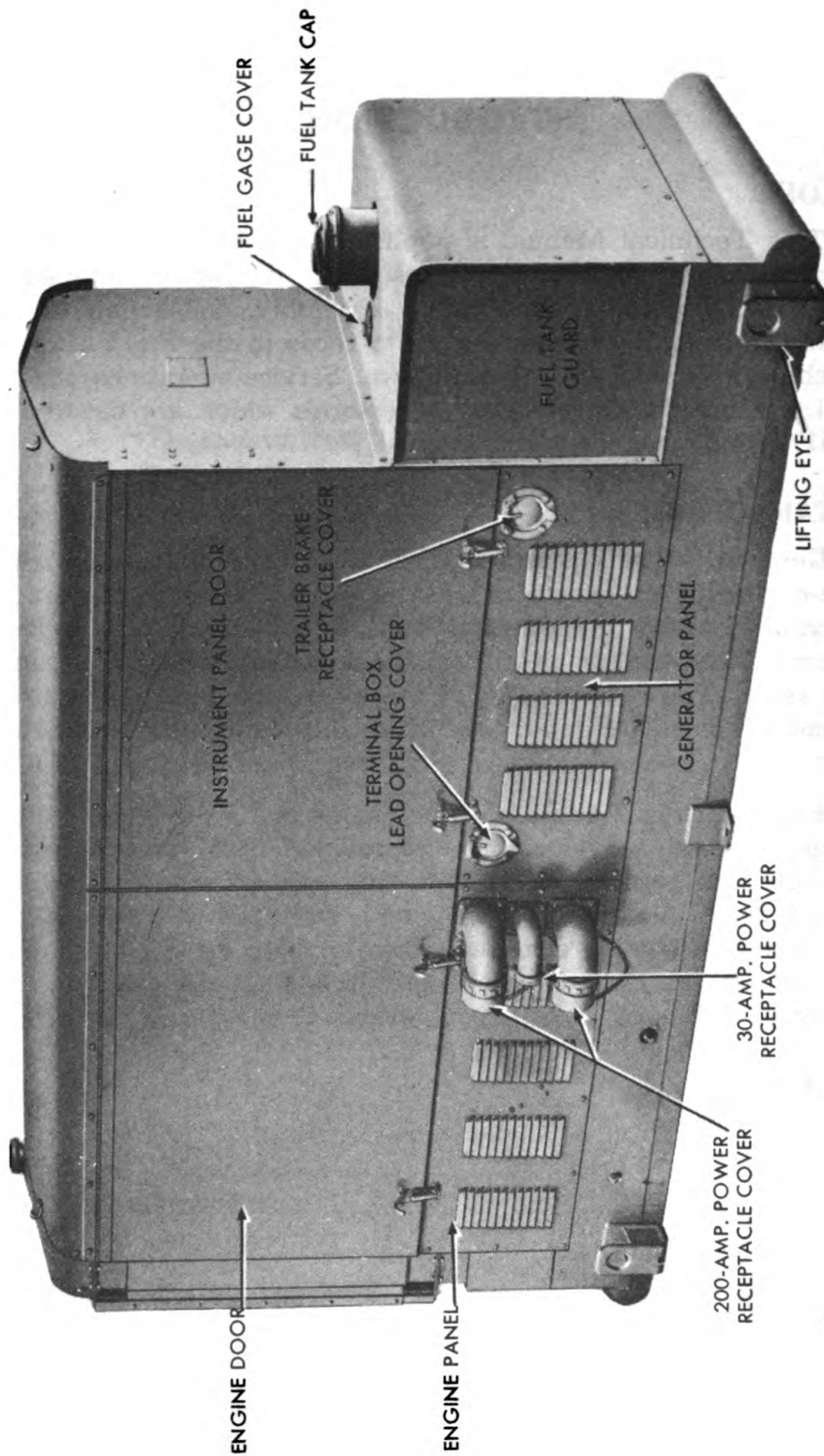
b. **Engine** (figs. 2 and 3). The engine is a six-cylinder, water-cooled gasoline engine, developing approximately 67 horsepower at 1,200 revolutions per minute. It is directly connected to the a-c generator by a flexible coupling. The engine is equipped with two electric starting motors, a battery charging generator with a two-charge regulator, an oil-bath air cleaner, and an oil filter. Engine speeds are controlled by a mechanical flyball-type governor.

3. DATA.

Model:

Generator	M3
Engine	Hercules WXLC-3
Weight, dry (complete unit).....	4,194 lb
Dimensions, over-all.....	100½ x 41⅝ x 56⅝ in.
Rated generator output.....	30kw (80 percent power factor), 3-phase, 60-cycle, 125-volt; or 30kw (80 percent power factor), 3-phase 60-cycle, 250-volt

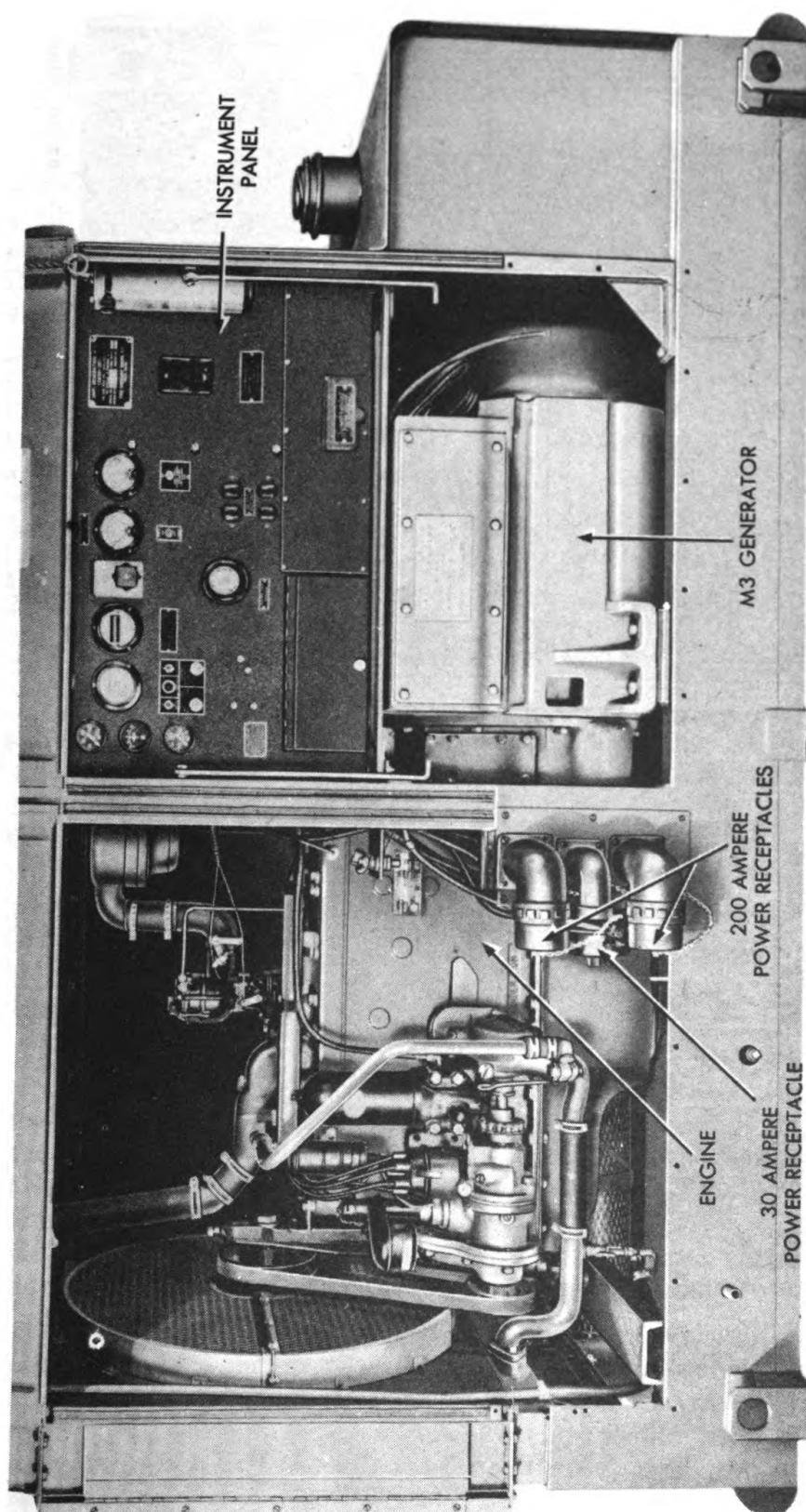
ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78103

Figure 1—Generating Unit M18—Left Rear

INTRODUCTION



RA PD 78545

Figure 2—Generating Unit M18—Doors Open and Panels Removed—Left Side

ORDNANCE MAINTENANCE—GENERATING UNIT M18

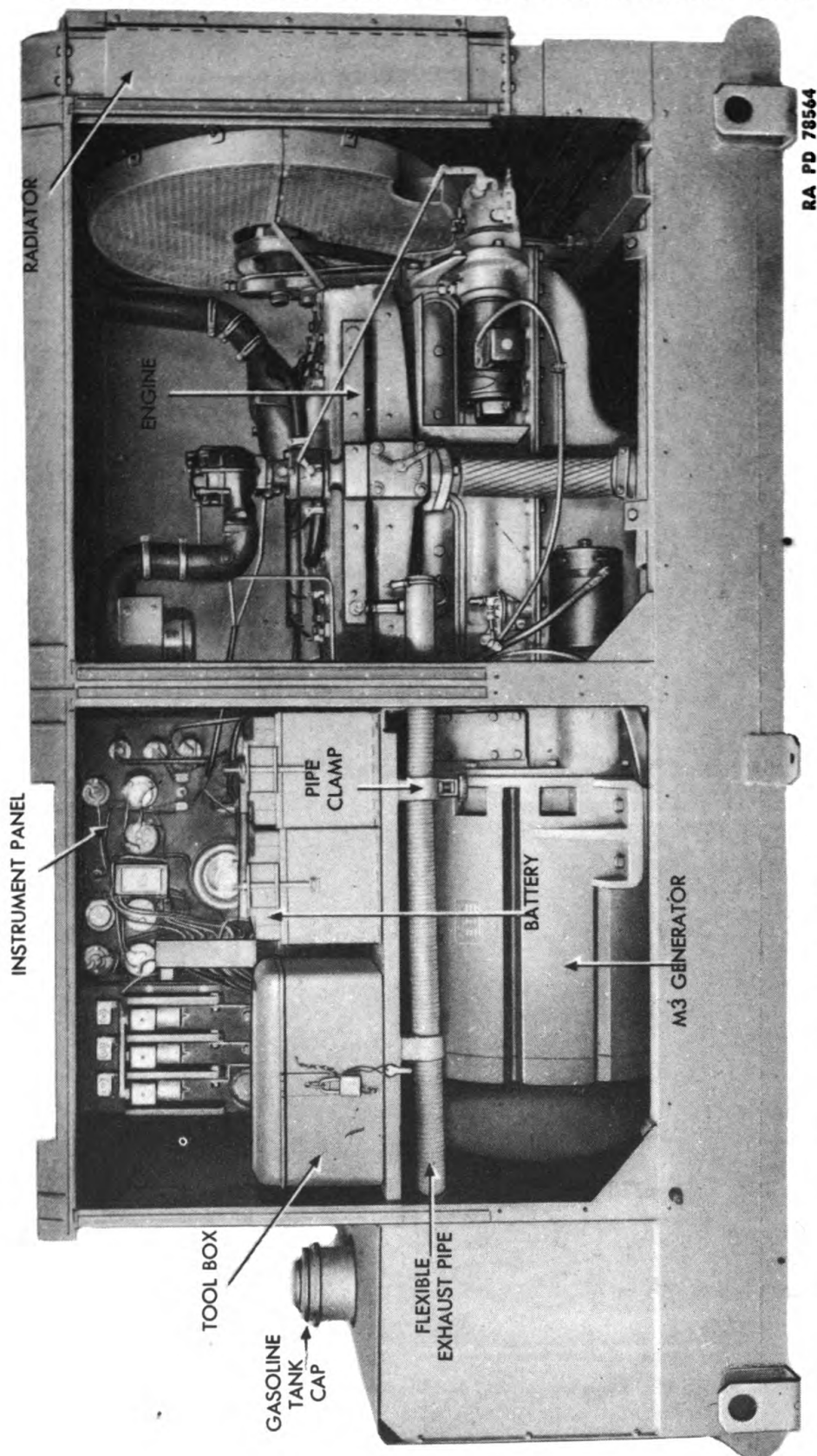


Figure 3—Generating Unit M18—Doors Open and Panels Removed—Right Side

CHAPTER 2

BASIC INSPECTION

4. GENERAL.

a. **Scope.** This section covers specific instructions for inspection by ordnance personnel of the materiel in the hands of troops, as well as instructions for higher echelons. General inspection instructions are contained in TM 9-1100, Inspection of Ordnance Materiel. The inspector should be well versed in maintenance procedures for the materiel and must have a working knowledge of the tools needed for its inspection.

b. **Purpose.**

(1) Fundamentally, inspection is for the purpose of determining whether or not the generating unit is serviceable, or the extent of its serviceability. Important but secondary purposes are the detection of incipient failure and the determination of whether or not proper care is being taken of the unit and accessories. Serviceability, as interpreted in this section, is the ability of the materiel to perform its intended functions completely.

(2) In the event the generating unit is unserviceable or incipient failures are disclosed, the cause and extent of the unserviceability will be determined. Such deficiencies as are found will be corrected on the spot or corrective measures will be taken. If the materiel must be "deadlined" or sent to a higher maintenance echelon for repair, it will be thoroughly and completely inspected, put into the best possible condition that time, materials, and tactical circumstances will allow, and returned to the using arm ready for immediate use.

c. **Reports.**

(1) Suggested improvements in design, maintenance, safety, and efficiency of operation, prompted by chronic failure or malfunction of the unit, spare parts, accessories, or equipment should be forwarded to the Office of the Chief of Ordnance, Field Service, Maintenance Division, with all pertinent information necessary to initiate corrective action. This information should be reported on WD AGO Form No. 468, Unsatisfactory Equipment Report. Such suggestions are encouraged so that other organizations may benefit from them.

(2) Report to the responsible officer any persistent carelessness or negligence in the observance of preventive maintenance procedures and safety precautions. This report should be accompanied by recommendations for correcting the unsatisfactory conditions. *NOTE: The inspector's aim is not to find fault with the using troops, but to be helpful.*

ORDNANCE MAINTENANCE—GENERATING UNIT M18**5. SPECIAL TOOLS.**

a. Simplicity of design of the generating unit makes it possible to perform all repair operations covered in this manual with standard automotive equipment.

6. INSPECTION RECORD.

a. A permanent record, listing any maintenance performed, should be kept of each inspection. A suitable inspection form, with an itemized listing of the points of inspection, can be prepared locally as a guide for maintenance personnel. Utility of the form will be increased if space is provided to record the date, action taken, and remarks for each period of inspection.

7. ENGINE AND ACCESSORIES.**a. Engine Proper.**

(1) Check exterior of engine oil pan, cylinder block, and cylinder head for cracks or leaks. Check for presence and condition of all gaskets. See that all cap screws and nuts are tight and equipped with lock nuts (if required).

(2) Test compression of engine (par. 10 c).

(3) Apply vacuum test to engine (par. 10 d).

(4) Run engine and observe functioning. Listen for piston slap, bearing knock, carbon knock, or other noises indicating malfunction.

b. Cooling System.

(1) Examine radiator for signs of leakage, bent fins, dirt in fins, dented or bent tubes or tanks, clogged overflow tube, nonfunctioning or missing doors, missing or poorly fitting radiator cap, and for dirt or rust in interior.

(2) Examine hose connection for leakage, loose clamps, or deterioration due to age. Feel hose for sponge-like deterioration on inside.

(3) Test operation of drain valve and inspect valve for leakage.

(4) Inspect water pump for cracks or leakage. Note position of water pump packing nut. If it is drawn up nearly to end of thread, need for repacking is indicated. Ascertain that shaft rotates freely.

(5) Inspect fan and bracket to see if either is broken or bent.

(6) Check fan belt for tension and for cracking, fraying, breaking, and to see if it is oil-soaked.

(7) Start engine to ascertain if cooling system functions properly. Remove radiator cap and see if coolant circulates properly after engine warms up and thermostat opens. Note fan to see if it vibrates or runs noisily.

BASIC INSPECTION

c. Battery Charging Generator and Regulator.

(1) Run engine and check functioning of charging system. Although a fully charged battery will cause the regulator to cut down charging rate, a charge should be shown by ammeter immediately after starting engine.

(2) Remove generator head band and check brushes for arcing. Stop engine and inspect brushes to see if they are broken or worn out (usable to one-half original length). Check spring tension of brush springs to see if they hold brushes snugly against commutator. Spring tension on collector brushes is 8 ounces per brush (minimum); on commutator brushes, 12 to 14 ounces. Notice if commutator is roughened. Inspect wiring to see if all connections are tight. Burned or scorched lead wires or coils indicate a short circuit. Test generator securing screw and lock washer for tightness.

(3) Remove cover from generator regulator. Check voltage regulator spring and circuit breaker springs to see that they are securely hooked to armatures and frames. Check resistor nuts and terminal screw for tightness. Check points to see if they are pitted or dirty. Check air gaps of armatures and contacts of voltage regulator and circuit breaker (par. 50 c). Remove screws which attach regulator to generator. Check terminal screws for tightness. Inspect all wires and coils to ascertain condition of insulation.

d. Ignition System.

(1) Test operation of spark coil (par. 53 a). Examine case and cover for cracks or damage from accident. Note condition of threads on terminals. Check for presence and tightness of lock washers and nuts on attaching screws and terminals.

(2) Test and inspect spark plugs (par. 55 a).

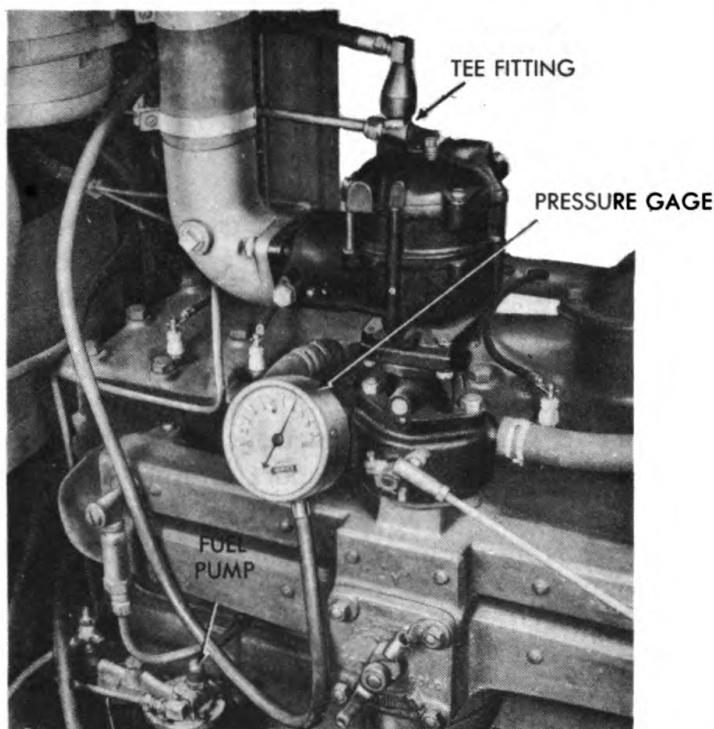
(3) Remove distributor cap and inspect for presence of cracks, or burned or pitted cap inserts. Remove rotor and inspect for cracks and bent, scored, pitted, or worn contact spring and tip. Remove plate which covers points and condenser. Inspect breaker points for pitting or burning. Check breaker point gap, and set at 0.020 inch. Check cam for wear. Test shaft for side play indicating bearing wear, and for backlash indicating gear wear.

(4) Test distributor timing and adjust if necessary (par. 54 g).

e. Starting Motors and Batteries.

(1) Test action of starting motors. Check tightness of attaching cap screws and terminal nuts. Check for presence of lock washers on attaching screws and terminals. Remove head band. Check brushes to see if they arc, or are broken or worn out (usable to one-half original length). Test tightness of wire connections. See if commutator is scored or roughened.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 79571

Figure 4—Testing Fuel Pump Pressure

(2) Check batteries with hydrometer to see if they are fully charged and in good condition. Inspect cases for cracks, connections for tightness and corrosion, and wires for condition of insulation.

f. Fuel System.

(1) Check gasoline tank for presence and condition of filler cap, flame arrester screen, and fuel gage. Check for leaks. Check tightness of pipe plug and fuel line connections. Check for dents serious enough to impair strength or capacity of tank.

(2) Check fuel lines, drain and shut-off valves for security of attachment, for leakage, for functioning, and for tightness of all connections.

(3) Inspect fuel pump case and sediment bowl for cracks and leaks. Check tightness of body screws and attaching screws. Check for presence of lock washers on screws. Check for sediment, water, and dirt in sediment bowl and screen. In case of doubtful fuel pump action, disconnect pump to carburetor tube and connect a tee fitting into it. Connect a pressure gage to the tee fitting, start engine, and measure the pressure the pump develops (fig. 4). It should develop a minimum of 2 pounds pressure.

(4) Inspect carburetor for leaks and security of attachment. Test

BASIC INSPECTION

operation of controls. Warm up engine and adjust idling mixture (TM 9-617).

(5) Examine throttle body to see if valve shaft rotates freely in bearings. Check body for cracks or leaks. Inspect water hoses for deterioration due to age or heat. Check tightness of hose clamps.

(6) Inspect air cleaner for security of attachment. Remove oil bowl and inspect for presence of vortex chamber and removable filter. Inspect all parts for dirt or sludge. Check tightness of hose clamps and condition of hose.

(7) Test governor action by running engine. It should hold engine at 1,200 revolutions per minute under full load, or 1,230 revolutions per minute with no load. Correct speed is indicated by 60-cycle reading on frequency meter. Check attaching screws, oil line, and lock nuts for tightness.

g. Exhaust System.

(1) Check exhaust tube and muffler for security of attachment, presence of insulating covers and insulation covers, and for presence of leaks.

(2) Inspect flexible exhaust pipe for breakage of flexible tube or clamp. Check flexible exhaust pipe guide and clamp (attached to under side of battery and tool box shelf) for security of attachment and proper functioning.

(3) Examine manifold to see if it is cracked or insecurely attached. Check manifold lever to see if it is in correct seasonal position ("HOT" for cold-weather operation; "COLD" for hot-weather operation).

h. Lubrication System.

(1) Warm up engine and check oil pressure. It should be 25 pounds at 1,200 revolutions per minute.

(2) Check oil lines and connections to governor and oil pressure gage for tightness and presence of leaks.

(3) Remove oil filter element and clean filter. Check oil passages in base and center tube for obstructions. Check felt washers which make up element to see if they are matted or torn.

(4) Remove, clean, and inspect oil strainer (par. 46). Check strainer gasket and oil pan gasket for damage permitting leakage.

8. GENERATING SYSTEM.

a. A-C Generator.

(1) Operate unit and check output. It should deliver 165 amperes at 125 volts, or 85 amperes at 250 volts.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(2) Remove fan guard and brush covers from rear of a-c generator. Operate unit and check brushes for arcing. Inspect alternator and exciter brushes to see if they are broken or worn out (one-half original length). Examine brush holders for weak springs. Springs must exert enough tension to hold brushes snugly against slip rings and commutator. Check brush lead wire connections for tightness (par. 85 d (16)). Inspect slip rings for scoring or pitting. Inspect commutator to see if bars are scored, pitted, burned, loose, or in a low or high position.

(3) Check generator to frame cap screws, and bell housing to generator cap screws for tightness and presence of lock washers.

b. Power Receptacles.

(1) Check tightness of connections of receptacle cables to terminals on back of load terminal box.

(2) Check for security of mounting and presence of covers on all three receptacles. Remove covers and inspect terminal insulators for cracks or dirt. Examine terminals to see if they are bent or corroded. Check receptacle bodies for fractures.

c. Load Terminal Box.

(1) From front of instrument panel, check tightness of door and box attaching screws and knurled screw door handle. Open door and check for presence of nut on each of the four connectors. Note condition of insulating bushing.

(2) From rear of instrument panel, test tightness of nuts which attach bus bar and cables to load terminal box. Check for presence of lock washers.

9. INSTRUMENT PANEL.

a. Check tightness of mounting bolts.

b. Check panel for dents or tears especially at screw holes.

c. Check instruments and controls for proper functioning.

d. Check tightness of all instrument and control attaching screws. Inspect screws for presence of lock washers where required.

e. Examine all connections of wires or tubes to instruments and controls for tightness. Inspect insulation on all wires on rear of panel to see if it has been injured or if it has deteriorated from age.

f. Test the three fuses on back of panel.

CHAPTER 3

GENERAL MAINTENANCE

Section I

TUNE-UP AND PERIODIC MAINTENANCE

10. TUNE-UP.

a. **General.** One of the most important operations in engine maintenance is frequent and proper tune-up. This operation, more than any other, contributes to maximum engine performance and economy. Ordinarily the engine should not be permitted to operate in excess of 150 hours without a complete tune-up.

b. **Procedure.** In order to avoid hit-and-miss methods, perform tune-up operations in order listed below.

c. **Compression** (fig. 5).

(1) Before making any checks on an engine, it should be run for several minutes to warm it up and lubricate the valve mechanism. The compression of the engine should be checked first, because an engine with uneven compression cannot be tuned successfully.

(2) Turn off the ignition and open the throttle valve to the wide-open position. Remove all spark plugs.

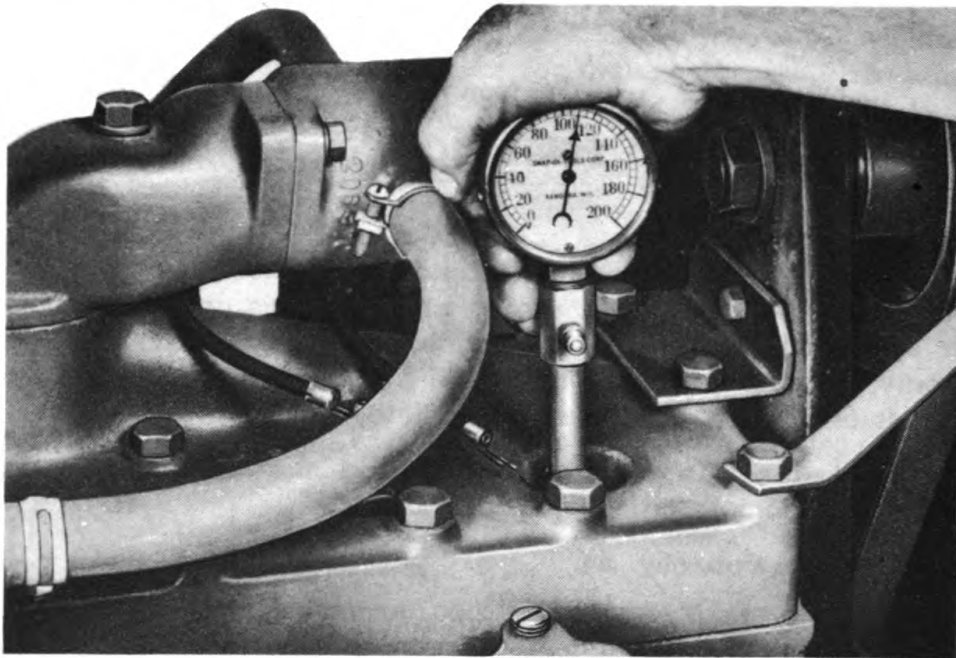
(3) Insert the compression gage in a spark plug hole, and hold it tightly in the hole. Crank the engine with the starting motor until the gage reaches its highest reading, which requires only a few turns. Repeat the same test on all cylinders, and make a note of the compression on each.

(4) The compression on all cylinders should be 110 pounds or better, and all cylinders should read alike, within 5 to 10 pounds, for satisfactory engine performance.

(5) Should there be a low compression reading on two adjacent cylinders, it indicates a possible inter-cylinder leak, usually caused by a leaking cylinder head gasket.

(6) If the compression readings are low or vary widely, the cause of the trouble may be determined by injecting a liberal supply of oil on top of the pistons of the low-reading cylinders. Crank the engine over several times, and then take a second compression test. If there is practically no difference in the readings when compared with the first test, it indicates sticky or poorly seating valves. If the compression reading on the low-reading cylinders is about uniform with the other cylinders, however, it indicates compression loss past the pistons and rings.

(7) The cause of low or uneven compression must be corrected before proceeding with an engine tune-up job.



RA PD 79552

Figure 5—Testing Compression

d. **Vacuum Test** (fig. 6). Remove one of the two pipe plugs on top of intake manifold and connect a vacuum gage to manifold. Start engine and run at idling speed until normal operating temperature is attained. A steady reading of 18 to 21 inches of vacuum at sea level indicates normal performance of engine at idling speed. If gage pointer fluctuates back and forth, a too rich or too lean fuel mixture is indicated. Adjust mixing screw at top of carburetor and throttle stop screw on side of carburetor to obtain maximum reading on vacuum gage and proper idling speed. If adjustment of carburetor does not cause normal reading of vacuum gage, and compression test indicated normal engine performance, remove and inspect carburetor (par. 15 b).

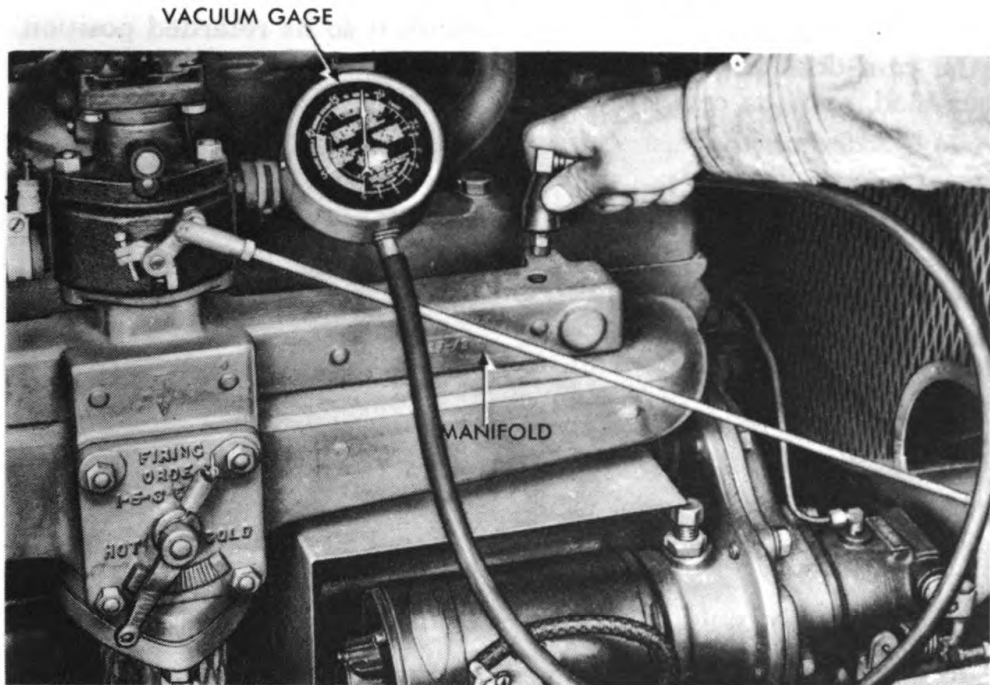
e. **Spark Plugs.**

(1) Clean the spark plugs thoroughly in a sand-blast spark plug cleaner. If the porcelains are badly glazed or blistered, replace the spark plugs. All spark plugs must be of the same heat range.

(2) Adjust the spark plug gaps at 0.025 inch, using a spark plug wire feeler gage. **CAUTION:** *Do not bend the center electrode.*

(3) Care must be used when installing the spark plugs, or the setting of the gap may be upset. When installing the plugs, screw the plug in fingertight, then tighten with the spark plug wrench one-half to three-quarters of a turn.

GENERAL MAINTENANCE



RA PD 79562

Figure 6—Testing Vacuum**f. Battery Test.**

(1) Connect the negative terminal of a voltmeter to the starting switch terminal, and the positive terminal of the voltmeter to a good ground.

(2) Crank the engine for 15 seconds with ignition switch turned off. If the starting motor cranks the engine at a good rate of speed with the voltmeter reading 10 volts or better, it indicates a satisfactory starting circuit, which includes the condition of the battery, terminals, and cables. However, if the cranking speed is slow, or the voltmeter reading is under 10 volts, the starting motor, battery, and battery cable terminals must be checked individually to locate the source of the trouble.

g. Distributor.

(1) Remove the spark plug wires from the distributor cap and examine the terminals for corrosion. Inspect the wires for damaged insulation and for being oil-soaked.

(2) Remove the distributor cap, and check the cap and distributor rotor for cracks or burned contacts.

(3) Check the automatic advance mechanism by turning the distributor cam in a clockwise direction as far as possible, then re-

ORDNANCE MAINTENANCE—GENERATING UNIT M18

lease the cam and see if the springs return it to its retarded position. If the cam does not return readily, the distributor needs to be disassembled, and the cause of the trouble ascertained (par. 54).

(4) Examine the distributor breaker points; clean the points if they are dirty, replace points if they are pitted or worn. Check the points for alinement, and aline them if necessary.

(5) Hand-crank the engine until the cam follower rests on a peak of the cam. Adjust the point gap to 0.020 inch, using feeler gage. This operation must be performed very accurately. Hand-crank the engine until the cam follower is located between the cam peaks. Hook the end of a point scale over the movable point, and pull steadily on the spring scale until the points just start to open. Scale should read between 17 and 20 ounces. Adjust the point pressure by loosening the screw which holds the end of the contact arm spring, and slide the end of spring in or out as necessary.

(6) Reassemble distributor cap and spark plug wires. Make sure that the terminals of the primary wire from the ignition coil to the distributor are clean and tight.

h. Fuel Pump. Remove the sediment cup and screen and wash them thoroughly in dry-cleaning solvent. When assembling, make sure that the cork gasket between bowl and pump body is in good condition and is properly seated. Tighten all fuel pump connections. Test fuel pump output with fuel pump gage (par. 7 f (3)).

i. Air Cleaner.

(1) Remove and disassemble (par. 32 a) air cleaner.

(2) Empty the oil out of the cleaner, and clean out all oil and accumulated dirt. Wash body with dry-cleaning solvent, and wipe dry. Wash filter element by slushing up and down in dry-cleaning solvent. Dry thoroughly, either with an air hose or by letting it stand until dry. Refill the cup of the cleaner to bead level.

(3) Assemble and install air cleaner (par. 32 c).

j. Carburetor. Adjust mixing screw at top of carburetor until engine runs smoothly at idling speed. This screw controls the amount of air mixed with the fuel.

k. Ignition Timing. Attach one wire of a neon timing light to No. 1 spark plug, and the other wire to the No. 1 spark plug wire. Start the engine and run it at idling speed. Loosen distributor clamp and slowly rotate distributor body clockwise or counterclockwise until the "DC" mark on the flywheel is visible through the timing hole in the bell housing each time the light goes on.

l. Valve Tappet Adjustment. Adjust the valve tappets according to the procedure given in paragraph 72 g.

GENERAL MAINTENANCE

RA PD 79557

Figure 7—Scraping Carbon From Piston Head**m. Cooling System.**

(1) Tighten all hose connections and examine for any indications of water leaks.

(2) Check the fan belt for cracks, oil-soaking, and for proper tension.

n. Oil Strainer. Drain oil pan strainer (par. 46).**11. 750-HOUR SERVICE.**

a. After engine has been run for 750 hours, remove cylinder head and thoroughly clean out all carbon deposits.

b. Remove manifolds and clean out all deposits.

c. Remove all valves and clean out valve guides with dry-cleaning solvent and wire brush.

d. Clean and regrind intake valves, making sure all deposits and gums are cleaned off the valve stems and from under heads of the valves.

e. Reface exhaust valve seats in block. (If refaced valve seats are wider than one-eighth inch, they must be narrowed with a 45-

ORDNANCE MAINTENANCE—GENERATING UNIT M18

degree stone or tool, taking material off the inside port until $\frac{1}{8}$ -inch width of seat is secured.)

f. Replace exhaust valves with new valves. -(If new valves are not available, the old ones can generally be reused after refacing in a grinder and thoroughly cleaning corrosion and deposits from the valve stems. Stems should then be polished with crocus cloth.)

g. Adjust tappet clearances to 0.010-inch intake and 0.016-inch exhaust. This is the first setting for a cold engine. After the engine has been run sufficiently to warm up, the clearances should be rechecked, and set to 0.006-inch intake, and 0.010-inch exhaust.

h. Clean heads of pistons and surface cylinder block of all carbon deposits (fig. 7). Flood piston tops with oil and turn over engine by hand. Wipe oil from cylinder bores when piston is at bottom of stroke. This is to remove fine particles of carbon which may work down between piston and cylinder wall during cleaning operation.

i. Install cylinder head, using new cylinder head gasket.

j. Install new spark plugs.

k. Install manifolds, using new gasket.

l. Clean radiator core with compressed air and brush, and install new fan driving belt, if required.

m. Install new distributor points and set gap at 0.020 inch. Lubricate the cam and pivot point of the new breaker arm, and check spring tension on the arm (par. 10 g). Set ignition timing on top dead center (par. 54 g).

n. Dismantle and clean carburetor jets and check float mechanism and needle valves (par. 33 a).

o. Assemble and install all accessories and connections, start engine, and warm up at idling speed until engine reaches normal operating temperature.

p. Recheck valve tappets and adjust to 0.006-inch intake and 0.010-inch exhaust.

q. Install valve cover plates, using new cork gaskets. (Use gasket cement on valve cover side only.) *NOTE: It is assumed that such parts as oil filter and air cleaner will be thoroughly washed and serviced, and that the lubricating oil will have been drained and replenished.* It is not necessary to remove the crankcase at this time unless there is evidence of loose bearings; or, due to dusty conditions or neglect of air cleaner servicing, the cylinder and pistons show abnormal wear.

GENERAL MAINTENANCE**Section II****TROUBLE SHOOTING****12. GENERAL.**

a. This section contains trouble shooting information and tests which can be made to help determine the causes of some of the troubles that may develop in this generating unit. Information given here is more complete than that given in TM 9-617. Each symptom of trouble given under the individual unit or system is followed by a list of possible causes of the trouble. Tests necessary to determine which one of the possible causes is responsible for the trouble are explained after each possible cause. Repairs which will correct the deficiencies are suggested.

13. ENGINE.**a. Engine Will Not Turn.**

(1) **HYDROSTATIC LOCK (WATER IN CYLINDER).** Remove spark plugs from cylinders and attempt to turn engine with hand crank. If engine turns, the lock will be relieved.

(2) **STARTER DRIVE MECHANISM JAMMED.** Remove and inspect both starting motors (par. 57). Replace Bendix drive if gear is worn. Install starting motors.

(3) **INCORRECT OIL VISCOSITY.** Drain engine and refill with proper lubricant (TM 9-617).

(4) **SEIZURE DUE TO INTERNAL DAMAGE.** Remove engine from unit (par. 58). Disassemble engine (par. 60) and inspect components.

b. Engine Turns; Will Not Start.

(1) **INOPERATIVE FUEL SYSTEM.** Open shut-off valves in gasoline line at tank and at fuel pump. Disconnect fuel line from carburetor. With ignition off, turn engine with starting motors. Unless fuel flows freely from line, fuel is not reaching carburetor (par. 15 a). **CAUTION:** *Avoid gasoline spilling on engine by catching it in a clean container.*

(2) **INOPERATIVE IGNITION SYSTEM.** Remove the cable from spark plug. Hold cable terminal one-quarter inch from cylinder head casting. Turn on ignition switch and crank engine. Ignition is inadequate if spark fails to jump the 1/4-inch gap. Check points, condenser, and/or coil.

(3) **SLOW CRANKING SPEED.** Replace batteries.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

c. Engine Does Not Develop Full Power.

- (1) **IMPROPER IGNITION.** Refer to paragraph 19.
- (2) **INADEQUATE COOLING.** Refer to paragraph 14.
- (3) **IMPROPER VALVE CLEARANCE.** Check valve clearance and adjust if necessary (par. 72 q).
- (4) **IMPROPER FUEL.** Drain fuel system and refill with clean gasoline.
- (5) **PREIGNITION.** If preceding steps fail to reveal cause of malfunction, spark plugs of improper heat range may be the cause of the trouble. Replace spark plugs with proper type plug.
- (6) **AIR LEAKS AT CARBURETOR OR MANIFOLD FLANGES.** With engine running at approximately 800 revolutions per minute, apply a small amount of oil at carburetor gaskets and flanges. If oil is sucked in, an air leak is indicated.
- (7) **INCORRECT GOVERNOR SETTING.** Disconnect governor linkage rod at throttle body and check for sprung linkage or stuck throttle. If throttle and linkage operate freely, start and accelerate engine. If speed of 1,200 revolutions per minute (indicated by full generator output) is reached, a faulty governor adjustment is indicated. Adjust governor (TM 9-617). *CAUTION: Do not open throttle valve more than necessary to determine that the engine will develop 1,200 revolutions per minute with governor disconnected. Excessive engine speed may damage engine and/or generator.*
- (8) **LOW ENGINE COMPRESSION.** Remove spark plugs and test compression with a compression gage. If readings vary by more than five pounds between cylinders, worn or damaged piston rings and/or valves, or a blown out cylinder head gasket is indicated. Remove cylinder head to determine fault.
- (9) **IMPROPER TIMING.** Adjust according to paragraph 54 g.

d. Engine Misfires.

- (1) **FAULTY STARTING SYSTEM.** Refer to paragraph 20.
- (2) **LOW ENGINE COMPRESSION.** Refer to subparagraph c (8), above.
- (3) **INCORRECT CARBURETOR ADJUSTMENT.** Adjust or repair carburetor (par. 33).
- (4) **CLOGGED FUEL TANK CAP VENT.** Remove obstruction from vent or replace cap.
- (5) **RESTRICTED FUEL FLOW.** Refer to paragraph 15 a and h.
- (6) **WATER IN FUEL.** Drain fuel system and strain gasoline through chamois skin or other filter which will not permit water to pass.

GENERAL MAINTENANCE

(7) **AIR LEAK IN INTAKE MANIFOLD OR CYLINDER HEAD.** Apply oil to edges of gaskets and run engine. If oil is sucked in, a leak is indicated. Replace leaking gaskets and tighten nuts securely.

(8) **CYLINDER HEAD GASKET DEFECTIVE, OR CRACKED WATER JACKET.** Remove cylinder head from engine (par. 60 a (4)) and inspect gasket, cylinder walls, and cylinder head. Replace gaskets or cylinder head if defective. Replace cylinder block if cracked.

e. Engine Vibrates Excessively.

(1) **MOUNTINGS LOOSE.** Check tightness of screws which attach front engine support to frame, and generator to engine and generator to frame. Tighten loose screws.

(2) **ENGINE MISFIRING.** Refer to subparagraph d, above.

f. Knock in Engine.

(1) **SPARK ADVANCED EXCESSIVELY.** Check distributor timing. Time if necessary (par. 54 g).

(2) **CARBON DEPOSITS IN CYLINDERS.** Remove cylinder head (par. 60 a (4)) and clean carbon from head and cylinder block.

(3) **LOOSE PISTON PINS.** Disassemble engine and replace piston pins (pars. 60 a (11) and 70 c).

(4) **LOOSE OR WORN ROD BEARINGS OR MAIN BEARINGS.** Disassemble engine (par. 60) and inspect all bearings. Replace worn parts.

(5) **CONNECTING RODS MISALINED.** Disassemble engine and connecting rods. Align or replace misaligned rods (par. 70).

(6) **END PLAY IN CAMSHAFT.** Loosen lock nut on camshaft end play adjusting screw at front end of engine. Tighten end play adjusting screw so as to barely feel shaft, then back off one-quarter turn. Tighten lock nut.

(7) **VALVE TAPPETS LOOSE.** Adjust valve clearance to 0.006-inch intake and 0.010-inch exhaust (hot engine).

(8) **FLYWHEEL LOOSE.** Remove engine from unit (par. 58). Take off nuts which attach flywheel to crankshaft. Inspect threads of nuts and bolts carefully. Replace parts having damaged threads and install flywheel tightly. Install new cotter pins through bolts and nuts.

g. Grinding or Scraping Noise in Engine.

(1) **BATTERY CHARGING GENERATOR BEARINGS WORN.** Replace generator (par. 49 a).

(2) **WATER PUMP BEARINGS WORN.** Replace water pump (par. 30).

(3) **BROKEN PISTON OR PISTON RINGS.** Disassemble engine and

ORDNANCE MAINTENANCE—GENERATING UNIT M18

inspect piston and piston rings. Replace broken and worn parts (par. 70 b).

14. COOLING SYSTEM.**a. Engine Overheats.**

(1) **INSUFFICIENT COOLANT.** Fill cooling system and inspect hose connections, radiator, and gaskets for evidence of leakage. Replace faulty parts and tighten loose connections.

(2) **RADIATOR DIRTY ON INSIDE OR OUTSIDE.** Drain and flush cooling system (par. 27). Blow dirt from radiator fins with compressed air.

(3) **CLOGGED COOLING SYSTEM.** Flush system. If trouble persists, disconnect radiator from engine and reverse-flush engine and radiator (par. 27).

(4) **THERMOSTAT STUCK CLOSED.** Replace thermostat.

(5) **WATER PUMP INOPERATIVE.** Drain system and remove plug from top of pump. Crank engine and observe impeller action through plug opening. Repair or replace pump if impeller does not turn.

(6) **FAN BELT SLIPPING.** Adjust fan belt to proper tension. Inspect belt and replace if greasy.

(7) **FAULTY IGNITION.** Refer to paragraph 19.

b. Engine Slow To Warm Up.

(1) **THERMOSTAT STUCK OPEN.** Replace thermostat.

15. FUEL SYSTEM.**a. Fuel Does Not Reach Carburetor.**

(1) **LACK OF FUEL.** Check quantity of fuel in tank. Replenish supply if depleted.

(2) **SHUT-OFF VALVES CLOSED.** Open shut-off valves in gasoline line at tank and at fuel pump.

(3) **GASOLINE TANK CAP VENT CLOGGED.** Remove obstruction from vent, or replace cap.

(4) **INOPERATIVE FUEL PUMP OR CLOGGED FUEL LINES.** Disconnect carburetor lines from fuel pump. Crank engine. If fuel flows from pump, an obstruction is in carburetor line. If fuel fails to flow from pump, remove tank line from fuel pump. If fuel flows from tank line, a faulty fuel pump is indicated. Repair or replace pump, if faulty (par. 36). If fuel fails to flow from tank line with both shut-off valves open, an obstructed line is indicated. Remove line and blow out with compressed air.

GENERAL MAINTENANCE

b. Fuel Does Not Reach Engine.

(1) **CARBURETOR CLOGGED.** Disassemble, clean, inspect, and repair carburetor (par. 33 a).

(2) **THROTTLE NOT OPENING.** Disconnect governor linkage rod from throttle body. Start engine and operate throttle manually. This will free throttle if stuck. If throttle works satisfactorily, a defective governor is indicated. Disassemble and repair defective governor (par. 35 a). **CAUTION:** *Do not allow engine to develop speed in excess of 1,200 revolutions per minute while operating throttle manually.*

c. Gasoline Leaks From Fuel Pump.

(1) **LOOSE SEDIMENT BOWL.** Tighten bowl retaining nut on wire bail.

(2) **DEFECTIVE SEDIMENT BOWL GASKET.** Replace gasket.

(3) **LOOSE FUEL LINE NUTS.** Tighten fuel line nuts. Replace nuts if threads are stripped.

(4) **BROKEN FUEL PUMP DIAPHRAGM.** This condition is indicated if fuel drips from bottom of pump. Replace diaphragm if damaged (par. 36 a).

d. Fuel Pump Delivers Less Than 2 Pounds Pressure.

(1) **STUCK VALVE.** Remove air dome and valve cap and lift valve springs and valve from seat. Clean valve seat and springs. Replace damaged parts.

(2) **AIR LEAKS IN SYSTEM.** Tighten all connections.

(3) **DIAPHRAGM, DIAPHRAGM SPRING, OR LEVER BROKEN.** Disassemble fuel pump and inspect all parts carefully. Replace broken or worn diaphragm (par. 36 a).

e. Excessive Fuel Consumption.

(1) **AIR CLEANER FOULED.** Service air cleaner.

(2) **CARBURETOR IMPROPERLY ADJUSTED.** Adjust or repair carburetor (par. 33).

(3) **CARBURETOR FOULED.** Disassemble carburetor (par. 33). Clean and inspect all parts. Be sure to remove obstruction from all passages.

f. Gasoline Leaks From Carburetor.

(1) **LOOSE SCREWS OR WORN GASKETS.** Tighten screws. If leak persists, disassemble carburetor and repair or replace carburetor (par. 33).

(2) **NEEDLE VALVE WORN OR NOT SEATING PROPERLY.** Remove

ORDNANCE MAINTENANCE—GENERATING UNIT M18

carburetor cover and check for dirt under needle valve. Repair needle valve or replace carburetor (par. 33).

(3) **DEFECTIVE FLOAT.** Remove carburetor cover and inspect float. Repair float if defective (par. 33).

(4) **CHOKE VALVE CLOSED.** Open choke valve. If stuck, disconnect control from carburetor and ascertain if control or valve is at fault. Free up or replace sticking parts.

16. EXHAUST SYSTEM.**a. Exhaust Fumes in Engine Compartment.**

(1) **FAILURE TO USE FLEXIBLE EXHAUST PIPE.** Attach flexible exhaust pipe to muffler before starting engine.

(2) **LOOSE OR LEAKING MANIFOLD GASKET OR CRACKED MANIFOLD.** Inspect manifold. Replace manifold if cracked. Tighten manifold if loose. Replace manifold gaskets if leaking.

(3) **EXHAUST TUBE LOOSENED FROM MANIFOLD OR MUFFLER.** Inspect exhaust tube attachment at both ends. Tighten loose nuts. Replace companion flange gasket if it leaks after tightening.

(4) **UNSERVICEABLE EXHAUST TUBE OR MUFFLER.** Remove insulation from exhaust tube and muffler (pars. 41 a and 42 a). Inspect tube and muffler to see if seams are open, or if metal is corroded. Replace unserviceable muffler.

17. ENGINE LUBRICATION SYSTEM.**a. Low or No Oil Pressure.**

(1) **INSUFFICIENT OIL.** Check oil on oil gage stick. Add oil to bring to "4/4" mark. Visually inspect external oil lines for leaks.

(2) **LOW OIL PRESSURE AFTER ENGINE WARMS UP.** Start engine, if oil pressure is normal while engine is cold but starts to drop while it is warming up, loose connecting rod and/or main bearings is indicated.

(3) **OIL PRESSURE GAGE INOPERATIVE.** Disconnect gage and temporarily connect line to a gage known to function properly. Start engine. Normal functioning of test gage indicates defective gage installed on instrument panel. Replace gage if defective.

(4) **PRESSURE RELIEF VALVE STUCK OR SET TOO LOW.** Watch pressure gage; turn oil pressure adjusting screw and check for variation of pressure. No change in pressure indicates defective relief valve. Disassemble relief valve and inspect parts. Adjust valve if out of adjustment.

(5) **IMPROPER VISCOSITY OIL.** Drain oil and fill crankcase with seasonal grade oil.

GENERAL MAINTENANCE

(6) **OIL STRAINER CLOGGED.** Remove oil strainer from oil pan (par. 46 a). Clean strainer screen with dry-cleaning solvent.

(7) **OIL PUMP GEARS WORN.** Remove oil pump from engine (par. 47 a). Disassemble pump and inspect parts (par. 47 b). Replace worn and damaged gears.

18. BATTERIES AND GENERATING SYSTEM.

a. Battery Discharged.

(1) **SWITCHES LEFT ON WHEN NOT IN USE.** Turn off switches when not in use. If ignition switch was left on, check condition of distributor breaker points.

(2) **GENERATOR INOPERATIVE.** Start engine and observe charging rate on ammeter. If no charge is shown with engine operating and with partially discharged battery installed in unit, a blown regulator fuse, faulty wiring, or inoperative generator or two-charge regulator is indicated. Trace wiring from generator to battery, noting condition of insulation. Test fuse in voltage regulator. Replace or repair defective wiring and replace defective fuses. If cause of trouble still has not been located, remove cover from two-charge regulator. With engine running, hold contact points of cut-out together, hold voltage regulator points closed, and observe ammeter. If charge is shown, a defective voltage regulator is indicated. If no charge is shown, a defective generator is indicated. Disassemble defective components. Clean and inspect all parts, replace unrepairable parts (generator, par. 49 a; two-charge regulator, par. 50 b).

(3) **BATTERY SHORTED INTERNALLY.** Test cells of batteries with hydrometer and with a high-rate discharge instrument. If any cell (or cells) is appreciably lower than the rest, an internal short in that cell (or cells) is indicated. Replace batteries which are shorted internally.

(4) **GROUNDING OR SHORTED CIRCUITS.** Install fully charged batteries in unit. Connect ground only. With all switches off, touch positive wire to positive post and watch for sparks. If sparks are observed, inspect wiring for damaged insulation. Replace faulty wires. Failure to locate trouble by above test indicates that trouble is in the ignition circuit. Trace wire from ignition switch to "IGN" terminal of terminal block, from terminal block to ignition coil, and from coil to distributor. Replace wires having damaged insulation. Failure to locate short circuit in wiring would indicate short circuit is in switch or coil. Replace or disassemble and repair defective units (switch, par. 105 b; coil, par. 53 a).

b. Ammeter Does Not Show Charge.

(1) **AMMETER INOPERATIVE.** Disconnect ammeter and tem-

ORDNANCE MAINTENANCE—GENERATING UNIT M18

porarily connect an ammeter known to function properly. Run engine. If test ammeter shows charge, replace ammeter.

(2) **LOOSE OR CORRODED CONNECTIONS OR BROKEN WIRES.** Trace wiring from generator to regulator, to terminal block, to ammeter, to ignition switch, to terminal block, to ignition coil, to distributor. Clean and tighten all connections and repair broken wires in the circuit.

(3) **GENERATOR AND/OR REGULATOR INOPERATIVE.** Refer to subparagraph a (2), above.

c. Ammeter Shows Excessive Charge.

(1) **TWO-CHARGE REGULATOR OUT OF ADJUSTMENT.** Adjust regulator (par. 50 c).

(2) **THIRD BRUSH IMPROPERLY ADJUSTED.** Remove head band from generator and slide third brush in direction of armature rotation.

d. Ammeter Shows Discharge With Engine Running.

(1) **TWO-CHARGE REGULATOR OUT OF ADJUSTMENT.** Adjust two-charge regulator (par. 50 c).

(2) **GENERATOR INOPERATIVE.** Disassemble generator. Clean and inspect all parts. Replace unrepairable generator (par. 49 a).

(3) **SHORTED CIRCUIT.** Refer to short circuits in subparagraph a (4), above.

e. Ammeter Shows Heavy Discharge With Engine Stopped.

(1) **SHORTED CIRCUIT.** Refer to short circuits in subparagraph a (4), above.

(2) **REGULATOR CIRCUIT BREAKER POINT STUCK.** Disconnect batteries to stop discharge. Disassemble two-charge regulator; repair or replace assembly (par. 50).

(3) **AMMETER HAND STICKING OR AMMETER BURNED OUT.** Replace the instrument.

(4) **GENERATOR CAPACITOR SHORT CIRCUITED (APPLIES ONLY TO UNITS HAVING RADIO NOISE SUPPRESSION SYSTEM).** Disconnect lead wires of capacitors in "CG" circuit. One capacitor is mounted on load terminal box and other is mounted on generator. If discharge stops when either of capacitors is disconnected, a short is indicated in that capacitor. Replace shorted capacitors.

f. Ammeter Hand Fluctuates Rapidly.

(1) **GENERATOR OR REGULATOR FAULTY.** Refer to subparagraph a (2), above.

(2) **SHORTED CIRCUIT.** Refer to subparagraph a (4), above.

GENERAL MAINTENANCE**g. Ammeter Shows Low Charging Rate.**

(1) **BATTERIES FULLY CHARGED.** Test batteries with hydrometer. Low charge rate is normal if batteries are fully charged. This is due to action of two-charge regulator functioning normally.

(2) **THIRD BRUSH IMPROPERLY ADJUSTED.** Remove head band from generator and slide third brush in direction opposite armature rotation.

(3) **HIGH RESISTANCE IN CHARGING CIRCUIT.** Clean and tighten battery terminals and check circuits for loose or corroded connections. Clean and tighten all dirty or loose connections.

(4) **DIRT ON COMMUTATOR.** Remove head band from generator and inspect commutator. If dirt is in evidence, clean commutator by applying flint paper to commutator while engine is running.

h. Generator Noisy at Idle Speed.

(1) **DRY FAN BELT.** Hold a piece of graphite lubricant against belt for a moment, with engine running.

(2) **LOOSE POLE PIECE SCREW.** Remove generator from engine and tighten pole pieces securely.

(3) **COMMUTATOR DAMAGED.** Disassemble generator and replace armature (par. 49 a).

(4) **BROKEN BEARING.** Disassemble generator and replace broken bearing (par. 49 a).

19. IGNITION SYSTEM.**a. Engine Fails To Start; Ammeter Shows Pulsating Discharge.**

(1) **NO SPARK AT SPARK PLUG.** Inspect coil to distributor high-tension wire. Connect wire if disconnected, and replace if broken.

(2) **WEAK SPARK.** Clean and adjust distributor points (par. 54). If spark is still weak, replace condenser (par. 54 b (2)). If trouble persists, replace coil.

(3) **DISTRIBUTOR CAP CRACKED.** Carefully inspect distributor cap. Small cracks, often invisible in poor light, are sufficient to cause shorts. Replace cap if cracked.

(4) **GROUNDING DISTRIBUTOR ROTOR.** Replace rotor as indicated in paragraph 54 b.

(5) **DEFECTIVE SPARK PLUG CABLES.** Visually inspect cables. Replace if defective.

(6) **DEFECTIVE SPARK PLUGS.** Replace spark plugs.

b. Engine Fails To Start; Ammeter Shows Constant Normal Discharge While Engine Is Being Cranked.

(1) **DEFECTIVE OR GROUNDED COIL TO DISTRIBUTOR WIRE.** Inspect wire and replace if damaged.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(2) **DEFECTIVE BREAKER POINTS.** Clean or replace distributor breaker points and adjust gap (par. 54 b).

(3) **DEFECTIVE CONDENSER.** Remove and check condenser.

(4) **DEFECTIVE COIL.** Replace coil.

(5) **DEFECTIVE DISTRIBUTOR.** If trouble persists, a defective distributor is indicated. Disassemble distributor (par. 54 b). Clean and inspect parts (par. 54 c). Replace unrepairable distributor.

c. Engine Fails To Start; Ammeter Shows No Discharge.

(1) **BREAKER POINTS FAULTY.** Check for pitted or dirty breaker points. Clean or replace points and adjust gap to 0.020 inch.

(2) **OPEN CIRCUIT IN IGNITION SYSTEM.** Remove spark plug from wire and hold one-quarter inch from cylinder head casting. Turn on ignition and crank engine. Absence of spark indicates an open circuit. Trace two wires from distributor to ignition coil, one wire from coil to terminal block "IGN" terminal, one wire from terminal block to ignition switch, and one wire from ignition switch to ammeter. Tighten loose connections and replace broken wires. If no open circuit exists in wiring or connections, a faulty ignition switch or coil is indicated. Replace these assemblies, one by one, until faulty unit is discovered.

(3) **DISTRIBUTOR FAULTY.** If procedure outlined in step (1), above, failed to eliminate trouble, a faulty distributor is indicated. Replace unrepairable distributor.

20. STARTING SYSTEM.

a. Starting Motors Will Not Operate.

(1) **BATTERIES DISCHARGED.** Test batteries with a hydrometer. Recharge or replace if discharged.

(2) **STARTER SWITCH INOPERATIVE.** Short-circuit terminals on bottom of starter switch. If starting motors operate, a faulty switch is indicated. Replace switch. *NOTE: Use a heavy wire or bar when shorting terminals to prevent excessive heating.*

(3) **FAULTY WIRING.** If batteries are fully charged and starter switch is operative but current does not reach starting motors, faulty wiring is indicated. Inspect wiring, tighten loose connections, and replace broken wires.

(4) **STARTING MOTORS INOPERATIVE.** Connect positive lead of voltmeter to starting motor terminal. Ground voltmeter negative lead to frame. Depress starter switch and observe voltmeter reading. If 12-volt reading is obtained and starting motor tested does not function, starting motor is inoperative. Test each starting motor in this manner. Disassemble inoperative starting motors (par. 57 a). Replace unrepairable starting motor.

GENERAL MAINTENANCE**b. Starting Motors Operate and Engage Flywheel but Do Not Turn Engine.**

(1) **BATTERIES DISCHARGED.** Check batteries with a hydrometer. Recharge or replace discharged batteries.

(2) **HYDROSTATIC LOCK IN CYLINDER.** Hydrostatic lock is discussed in paragraph 13 a.

(3) **BENDIX GEAR DAMAGED OR STUCK.** Remove starting motor from engine and Bendix drive from starter (par. 57 a). Clean and inspect drive. Replace defective parts.

c. Slow Cranking Speed.

(1) **HIGH ELECTRICAL RESISTANCE.** Visually inspect starting motor and battery circuit to see if any terminals are loose or corroded or if undersize wires have been installed in circuit. Check operation of starter switch (subpar. a (2), above), and starting motors (subpar. a (4), above). Clean and tighten loose connections. Replace undersize wires with proper size wires; replace starter switch if test shows it to be faulty. Disassemble and repair starting motors if high resistance is indicated within them.

(2) **ENGINE OIL TOO HEAVY.** Drain engine and fill crankcase with proper lubricant.

(3) **STARTING MOTORS BADLY WORN.** This condition is indicated by excessive noise during operation of starting motors. Disassemble worn starting motors and carefully inspect all parts (par. 52). Replace unrepairable starting motor.

21. LIGHTING SYSTEM.**a. Instrument Panel 6-volt Light Will Not Burn.**

(1) **BURNED-OUT FUSE.** Pull fuse from clips adjacent to small terminal block on back of instrument panel. Install a new fuse.

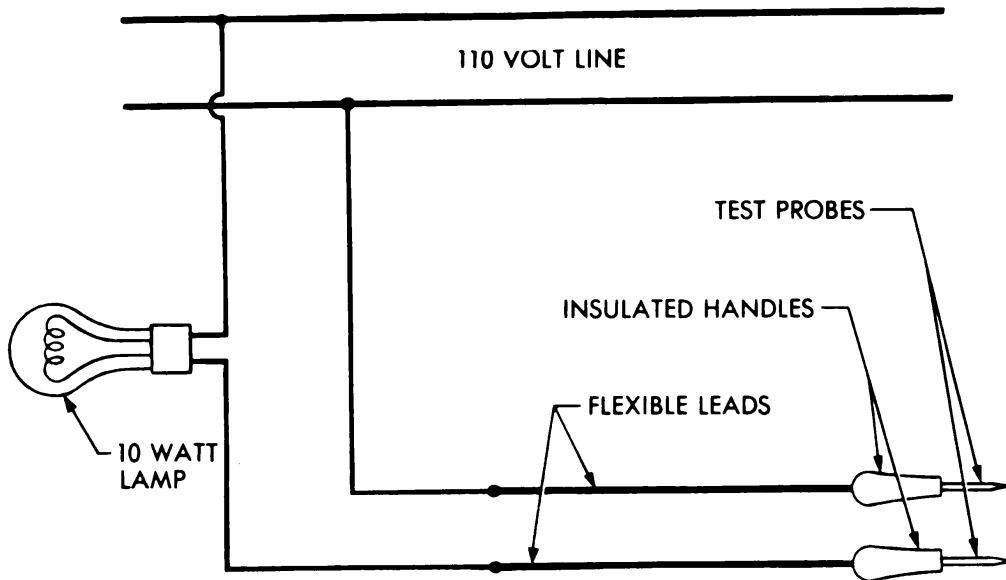
(2) **BURNED-OUT LAMP.** Remove lamp from socket and test with 6-volt current. Replace lamp if it fails to light.

(3) **OPEN CIRCUIT IN WIRING OR SWITCH.** Inspect wire from light switch. Replace if damaged; connect if disconnected. Short circuit terminals on rear of switch. A defective switch is indicated if lamp lights. Replace switch if defective. Trace wiring from switch to "63" terminal of small terminal block, from terminal block to fuse, from fuse to "61" terminal of terminal block, and from terminal block to battery. Clean and tighten corroded or loose connections. Replace broken wires.

b. Six-volt Light Burns Out Continuously.

(1) **HIGH RESISTANCE IN BATTERY GROUND CIRCUIT.** Inspect battery ground circuit cable. Clean and tighten its connections.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 24635

Figure 8—Test Lamp Diagram

(2) **GENERATOR REGULATOR OUT OF ADJUSTMENT.** Adjust regulator (par. 50 c).

22. A-C GENERATING SYSTEM.

a. General.

(1) **TYPES OF MALFUNCTIONS.** Three things can go wrong with coils or lead wires of a generator: open circuit, short circuit, and a ground.

(a) *Open Circuit.* An open circuit is caused by a break in a wire or by an opening of a connection between two wires. This breaks the circuit because the current has no path to follow.

(b) *Short Circuit.* A short circuit is caused by lack of insulation on two touching wires. This enables the current to take a "short cut" instead of traversing the route of its proper course.

(c) *Ground.* A ground is caused by lack of insulation on a wire or coil at point of contact with framework of generator. This allows the current to flow into the framework instead of following its proper course.

(2) **CONSTRUCTION OF TEST LAMP** (fig. 8). Connect in series a probe, a battery or other source of current, a lamp, and another probe. Test operation of test lamp by touching the points of the two probes together. The lamp should light.

(3) ISOLATION OF MALFUNCTION.

(a) *Check for an Open Circuit.* Place test lamp probes on bare

GENERAL MAINTENANCE

wire at extremities of wire or coil being tested. If the lamp lights, a continuous circuit is indicated. Failure of lamp to light indicates an open circuit.

(b) *Check for a Short Circuit.* No specific procedure which will apply in all cases can be given. Loss of generator power and presence of excessive heat indicate a short circuit.

(c) *Check for a Ground.* Place one probe of test lamp on bare metal of suspected coil or wire. Touch other probe to unpainted surface of generator frame. Lighting of test lamp indicates presence of ground. Failure of lamp to light indicates absence of ground.

b. Symptom—No Amperes at Rated Voltage.

(1) Turn circuit breaker "ON." Test for open circuit from "A" terminal of power receptacle to terminal at lower left (facing rear of instrument panel) of rear of circuit breaker panel. Repeat test from "B" terminal of power receptacle to terminal in bottom center of circuit breaker panel. Repeat test from power receptacle "C" terminal to lower right terminal on circuit breaker panel. Repair or replace wiring of any circuit on which test lamp fails to light.

(2) If the procedure indicated in subparagraph a (3) (a), above, shows no open circuit, an open circuit is indicated in wiring to or within motor of appliance operated by unit.

c. Symptom—Excessive Amperes at Rated Voltage.

(1) Test for open circuit in "B" circuit (subpar. a (3) (a), above).

(2) Test ammeter by disconnecting it and connecting into circuit an ammeter known to be good. Replace ammeter if it registers incorrectly.

(3) Check wiring and connections in "B" circuit (from "B" terminal of receptacle) to unit with test lamp. Look for open circuit or poor connections.

d. Symptom—Insufficient Amperes at Rated Voltage.

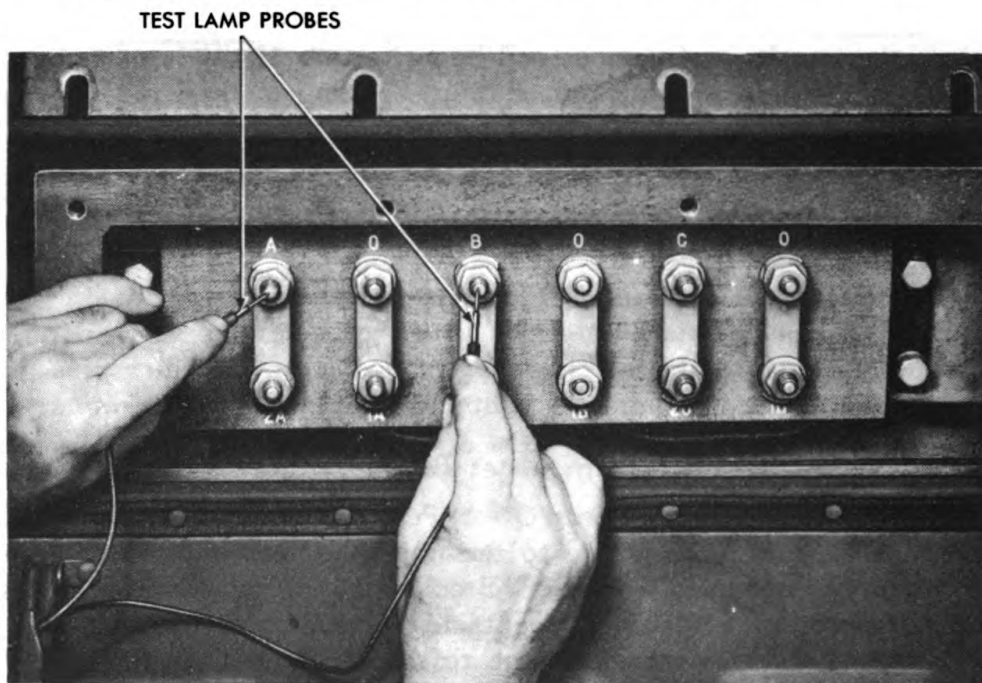
(1) Check links of generator terminal box to be sure they are properly connected.

(2) Check "A," "B," and "C" circuits from generator to receptacle with test lamp (subpar. a (3) (a), above).

(3) Test wiring in circuit exterior to unit for short circuit, open circuit, and poor connections with test lamp. Repair or replace defective wiring.

(4) If above steps fail to reveal the cause, a defective motor on appliance being operated by unit is indicated.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78615

Figure 9—Checking Generator Operation**e. Symptom—No Amperes and No Voltage.**

(1) Start engine and turn on circuit breaker. Using a standard 110-volt trouble lamp, apply probes at terminals "A" and "B" of generator terminal box (fig. 9). Repeat the test from terminal "A" and "C" and then from terminal "B" and "C." Stop engine. Interpret results as follows:

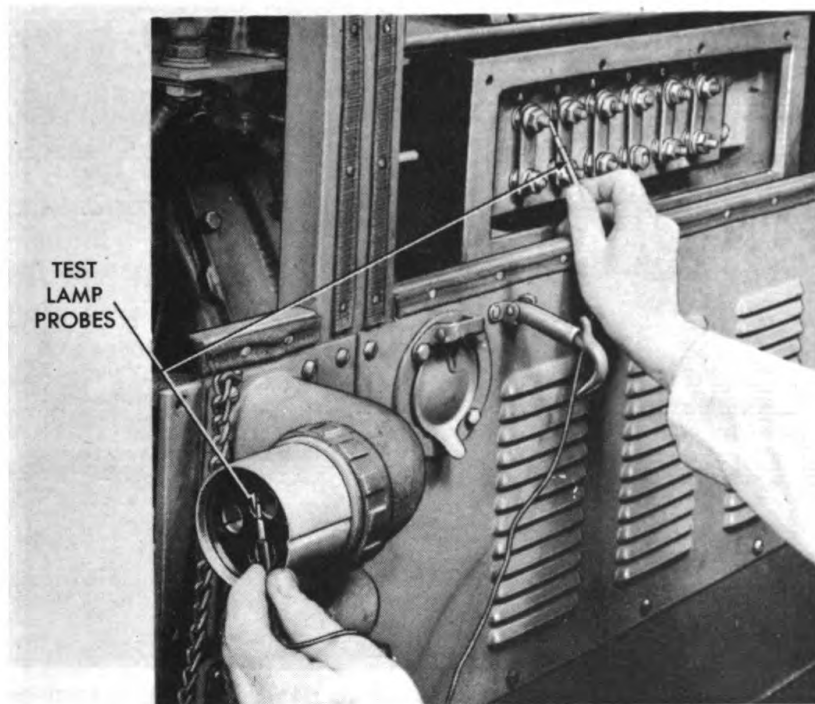
(a) *Lamp Lights on All Three Tests.* Generator is functioning. Proceed with step (2), below.

(b) *Lamp Fails To Light on Two of the Tests.* Open circuit in stator or stator leads is indicated. Disassemble generator and repair stator, or replace frame and stator (par. 82).

(c) *Lamp Fails To Light on All Three Tests.* Proceed with step (3), below.

(2) Leave circuit breaker turned on. With a test lamp, test for an open circuit between generator terminal box terminal "A" and power receptacle terminal "A" (fig. 10). Repeat test from generator terminal box terminal "B" and power receptacle terminal "B." Repeat test from generator terminal box terminal "C" to receptacle terminal "C." Failure of lamp to light on any of above tests indicates an open in circuit being tested. The open circuit may be in links at generator terminal box, generator to circuit breaker wiring, cross-current compensating transformer ("A" phase only), circuit breaker

GENERAL MAINTENANCE



RA PD 78598

Figure 10—Checking Receptacle Circuit

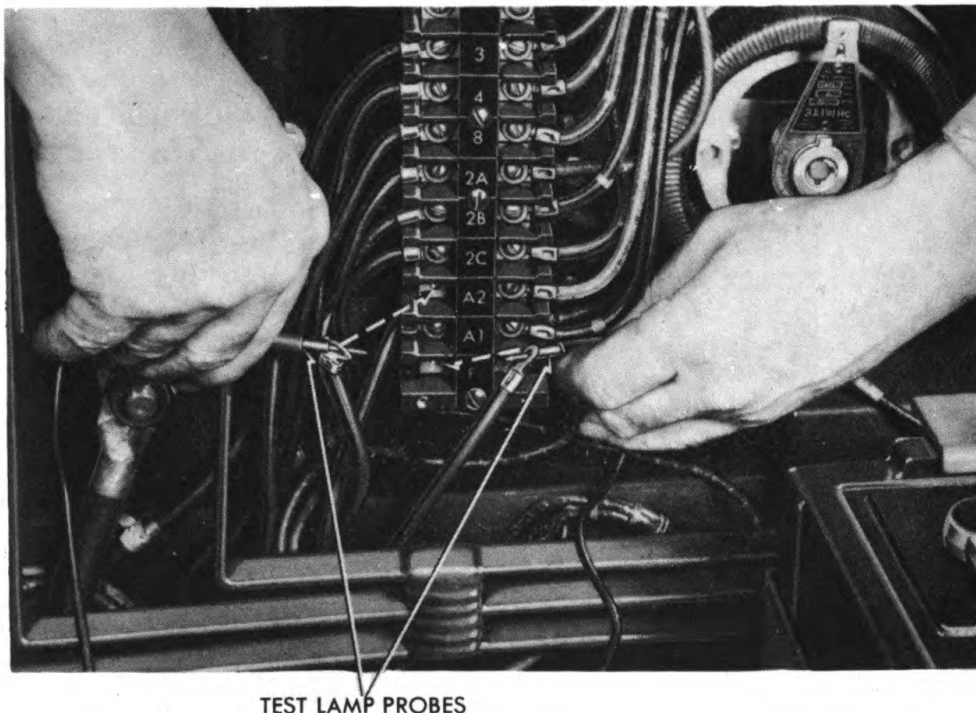
to load terminal box bus bar, load terminal box to power receptacle cables, or in power receptacles. Test each unit, each wire, and across each connection of phase showing an open. Repair or replace defective parts.

(3) Remove links from generator terminal box. With test lamp, test for open circuit from terminals "A" to "B," "B" to "C," and "A" to "C." Failure of lamp to light on all three tests indicates an open in stator or stator leads. Disassemble generator and repair or replace stator (par. 82). If lamp lights on all three tests, proceed with step (4), below.

(4) Remove rear fan guard and brush covers. Lift all four slip ring brushes from slip rings so none make contact. Test for an open circuit between the two slip rings. Failure of lamp to light indicates an open in revolving field coils or lead wires. Disassemble generator and repair or replace defective rotor or wires (par. 82). If lamp lights, proceed with step (5), below.

(5) Start engine. Turn on field rheostat as far as it will go clockwise. Test exciter voltage by placing probes of direct current voltmeter on any two adjacent exciter commutator brush holders. At least 62.5 volts should register. Three results are possible: no

ORDNANCE MAINTENANCE—GENERATING UNIT M18



TEST LAMP PROBES

RA PD 78607

Figure 11—Checking Exciter Field Circuit

voltage, low voltage, or correct voltage. Proceed as follows, depending on results of test:

(a) *No Voltage.* Connect jumper wire between terminals "F" and "A1" on large terminal block on back of instrument panel. Repeat test. If voltmeter shows 62.5 volts, an open in voltage regulator, field rheostat, or wires to them, or wire from commutator brush to slip ring brush, is indicated. Check individual units, wires, and across connections for an open circuit. Repair or replace faulty units or wires. If voltmeter still shows no voltage, examine commutator brushes to see if they are broken, worn, or wedged in holders. Examine brush holder springs to see if they hold brushes against commutator snugly. Replace faulty parts. Repeat test. If voltage is still absent, remove generator to terminal block leads from terminal block terminals "F" and "A2" (fig. 11). Test for open circuit from lead wire "F" to "A2" with test lamp. Failure of lamp to light indicates an open in exciter field circuit. Disassemble generator and repair or replace exciter field. If lamp lights, connect generator lead wire "F" to terminal block terminal "F," and disconnect generator lead wire "A1" from terminal block. Test for open from wire "A1" to wire "A2." Be sure slip ring brushes are lifted from slip rings during test. Failure of lamp to light indicates open in exciter armature circuit.

GENERAL MAINTENANCE

(b) *Low Voltage.* Follow procedure of step (a), above. Look for a high resistance or loose connection, faulty resistor, faulty field rheostat, faulty voltage control, or short circuit in exciter field coil or armature. Shorted coils or armature usually shows signs of heat.

(c) *Correct Voltage.* Correct voltage relieves the exciter of responsibility. Test lead wires from commutator brush to slip ring brush, and from exciter field to commutator brush for open circuits. Repair or replace wires having open circuits. Test connections at ends of wires and brush contacts for open circuit.

f. Symptom—Excessive Sparking at Commutator Brushes.

(1) **DIRTY OR PITTED COMMUTATOR.** Inspect commutator. If dirty or moderately rough, clean by holding No. 00 class B flint paper against it while it is slowly revolving. If badly scored, disassemble generator (par. 82) and turn down commutator on a lathe (par. 84 c (3)).

(2) **BROKEN OR WORN EXCITER BRUSHES.** Inspect brushes; if broken or worn to length of $\frac{3}{4}$ inch or less, replace.

g. Excessive Heating of Generator.

(1) **OVERLOADING.** Decrease load to an allowable limit.

(2) **OPEN OR GROUNDED COILS.** Refer to subparagraph e, above.

h. Excessive Noise in Generator.

(1) **WORN-OUT BRUSHES.** Inspect brushes. Replace if broken or worn to length of $\frac{3}{4}$ inch or less.

(2) **DAMAGED BRUSH SPRINGS.** Inspect springs and test spring tension. Adjust tension if necessary. Spring tension on collector brushes is 8 ounces per brush (minimum); on commutator brushes, 12 to 14 ounces. Replace springs if bent, broken, or burned.

(3) **COUPLING FAILURE.** Disconnect generator from engine (par. 81). Remove and disassemble front fan (par. 82 b). Replace broken or worn parts.

(4) **BROKEN BEARING.** Remove exciter field and brush holder support bracket from rear of generator (par. 82 a). Pull bearing from rotor shaft (par. 82 g (1)). Replace bearing.

i. Voltage Regulator Malfunctions.

(1) **GENERAL.** Malfunctioning of voltage regulator is indicated if generating unit works correctly when being controlled by means of exciter field rheostat, but malfunctions when voltage regulator is brought into circuit.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(2) VOLTAGE WILL NOT BUILD UP.

(a) Check vibrator action. If vibrator does not vibrate, there may be a loose or open connection in regulator or potential transformer circuit. Test for open circuit with a test lamp to see if voltage is reaching coil of the voltage regulator.

(b) Remove box from rear of voltage regulator and check regulator contacts. Contacts may be in need of cleaning. Clean with an automotive-type distributor contact file if necessary.

(c) Check exciter field rheostat to make certain that resistance is all the way out of the circuit for automatic operation.

(d) Voltage adjusting screw may be turned too far in decrease voltage direction. Turn screw counterclockwise to see if voltage comes up.

(3) VOLTAGE REGULATOR EXERTS NO CONTROL OVER OUTPUT.

(a) Check on-and-off switch to see if it is in position for automatic operation. Check exciter field rheostat to see that it is turned clockwise as far as it will go.

(b) Check resistors on back of regulator panel for open or short circuit. Replace defective resistors.

(c) Check relay coil for open circuit or short circuit. If relay coil has no voltage, regulator will not operate. The normal operation voltage on the relay coil is 40 to 60 volts alternating current.

(d) Check vibrator and points to see if vibrator is bent, or if regulator contacts are stuck. Replace defective parts.

(e) Voltage adjusting screw may be turned too far in the increase voltage direction. Turn screw clockwise to decrease voltage.

(4) VOLTAGE BECOMES ERRATIC.

(a) The anti-hunt calibrating resistor may be out of adjustment. To increase anti-hunt effect, increase the resistance of the anti-hunt calibrating resistor. In adjusting this resistor, never cut out more than 50 percent of the resistance. After changing this resistor setting, it will be necessary to reset the voltage by means of the voltage adjusting screw.

(b) Too high a resistance in hunt field resistor will cause regulator to hunt. Proper setting for hunt field resistor is just below the setting which produces hunting. Too low a setting will cause the sensitivity of the regulator to be poor. This resistor is properly adjusted at the factory and will normally not require further adjustment.

(c) Check tightness of regulator connections and regulator lead wire connections. Ascertain that no screw or other mechanical part of the voltage regulator relay is loose.

(d) Check regulator contacts to see if they are built up, pitted, or stuck. Replace contacts if defective.

GENERAL MAINTENANCE

(e) Relay air gap will sometimes affect the stability of the regulator. Check air gap and adjust if necessary. Reduce air gap to $\frac{1}{16}$ inch if necessary to eliminate holding.

(5) VOLTAGE SENSITIVITY IS POOR.

(a) Make sure that the exciter field rheostat resistance is completely out of the circuit (turned all the way to the right).

(b) Check voltage regulator to see if any screw or mechanical part of the relay has come loose. Tighten loose parts. Check all voltage regulator connections to see if any are loose. Clean and tighten loose connections.

(c) Check air gap between vibrator and core. Adjust to $\frac{1}{32}$ inch. Check contacts to see if they are built up, pitted, dirty, or worn. Clean, reface, or replace contacts as necessary.

(d) Check setting of the shunt field resistor in regulator. Too low a setting will decrease sensitivity. Increase as necessary.

(6) VOLTAGE DROPS EXCESSIVELY WITH INCREASE IN GENERATOR LOAD.

(a) Check regulator switch to be sure it is on.

(b) Check exciter field rheostat to be certain it is entirely cut out (knob turns to right as far as it will go).

(c) If neither of the above possibilities is at fault slightly increase the resistance of the shunt field rheostat.

(7) CONTACTS SPARK EXCESSIVELY.

(a) Check spark suppressor condenser to see if it is disconnected or open-circuited. A contact that does not spark may have a condenser with a short circuit in it. A contact whose spark is large (may show a yellow flame) may have a condenser that is open-circuited. A method of checking condensers is given in paragraph 118 f (5).

(b) Check lead wires between contacts and spark suppressor condensers to see if they are broken or have a loose connection. Replace broken lead wires. Clean and tighten loose connection.

(c) Check lead wire to shunt field resistor to see if it is broken or if a connection has come loose. Inspect resistor to see if it is burned out or broken. Replace defective parts. Clean and tighten loose connections.

(8) CONTACTS BUILT UP EXCESSIVELY. If capacity of spark suppressor condenser is too small, the cones on the contacts will build up blunt gray humps and the contact spark may tend to "flash over" at times. If condenser capacity is too large, the contacts will build up sharp dark humps and will tend to stick at times. Keep contacts smooth by filing them with a distributor contact file. If building up

ORDNANCE MAINTENANCE—GENERATING UNIT M18

reoccurs, replace spark suppressor condenser. NOTE: *Perfect contacts have a grainy metallic gray surface but are not necessarily smooth. Usually there is a dark ring around the edges.*

23. RADIO INTERFERENCE SUPPRESSION SYSTEM.**a. Unit Causes Radio Interference.**

(1) **IGNITION CIRCUIT NOISY.** Accelerate engine and turn off ignition switch. If crackling noise stops the moment the switch opens, interference from ignition circuit is indicated. Check shield to see if it is tight and to see if all secondary circuit wires are inside shield. Test capacitors connected to "IGN" circuit at coil and at load terminal box (par. 125 b). Test spark plug suppressors and ignition coil suppressor (par. 126 b). Inspect shielded wire of ignition primary circuit to see if shielding is in good condition and grounded. Replace all parts which are in unserviceable or questionable condition. Clean spark plugs. Adjust ignition points. Clean and tighten all connections.

(2) **TWO-CHARGE REGULATOR OR 125-VOLT VOLTAGE REGULATOR NOISY.** An irregular clicking noise which continues for a moment after ignition switch is turned off indicates noise in two-charge regulator or 125-volt voltage regulator. Inspect points on both regulators. Replace if pitted or worn. Adjust armature and contact point gaps (two-charge regulator, paragraph 50 c; 125-volt regulator, paragraph 121). Test capacitors mounted on load terminal box and battery charging generator which are connected in "A," "B," "C," and "CG" circuits (par. 125 b). Replace faulty capacitors. Clean and tighten all connections.

(3) **BATTERY CHARGING GENERATOR OR A-C GENERATOR NOISY.** A whining noise which varies with engine speed and continues for a moment after ignition switch is turned off, indicates that one or both of the generators are noisy. Inspect brushes in both generators. Replace worn brushes. In case arcing is noted on a-c generator brushes, locate and correct the cause (par. 22 f). Inspect shielded wire in battery charging generator "CG" circuit to see if shielding is in good condition and grounded. Test capacitors in following circuits: "A," "B," "C," "O," and "CG" (par. 125 b). Replace unsatisfactory or questionable capacitors. Clean and tighten all connections in both generator circuits.

(4) **GROUND CONNECTORS OR BOLTS LOOSE OR MISSING.** An irregular crackling noise indicates lack of continuity of circuit throughout unit. Tighten all housing and frame nuts and screws. Clean and tighten connections of all six ground connectors. Replace all missing bolts, nuts, screws, and ground connectors.

CHAPTER 4

ENGINE AND ACCESSORIES

Section I

ENGINE (GENERAL)

24. DESCRIPTION (figs. 12 and 13).

a. **Cylinders and Main Bearings.** Cast integrally; the cylinder block and crankcase constitute the main frame of the engine. All cylinders are water-jacketed the full length of the bore. Seven main bearings support the crankshaft. These bearings contain babbitt-lined shells. The lower shell is secured in place by a drop-forged bearing cap. Each bearing cap is attached to the block with two or four bolts drilled for safety wire. The cylinder head is of the conventional L-type.

b. Connecting Rods and Pistons.

(1) Babbitt-lined, removable shells are used in the connecting rod bearings. Two alloy steel bolts and nuts locked in position with cotter pins secure each bearing cap to its connecting rod. The piston pin is clamped into the top of the rod by means of a screw. A notch in the pin is provided to receive the edge of the clamp screw. This device prevents the piston pin from working loose and scoring the cylinder walls.

(2) Aluminum pistons are used. No bearings or bushings are provided for the piston pin. Each piston has three compression rings and one oil ring. All rings are above the piston pin.

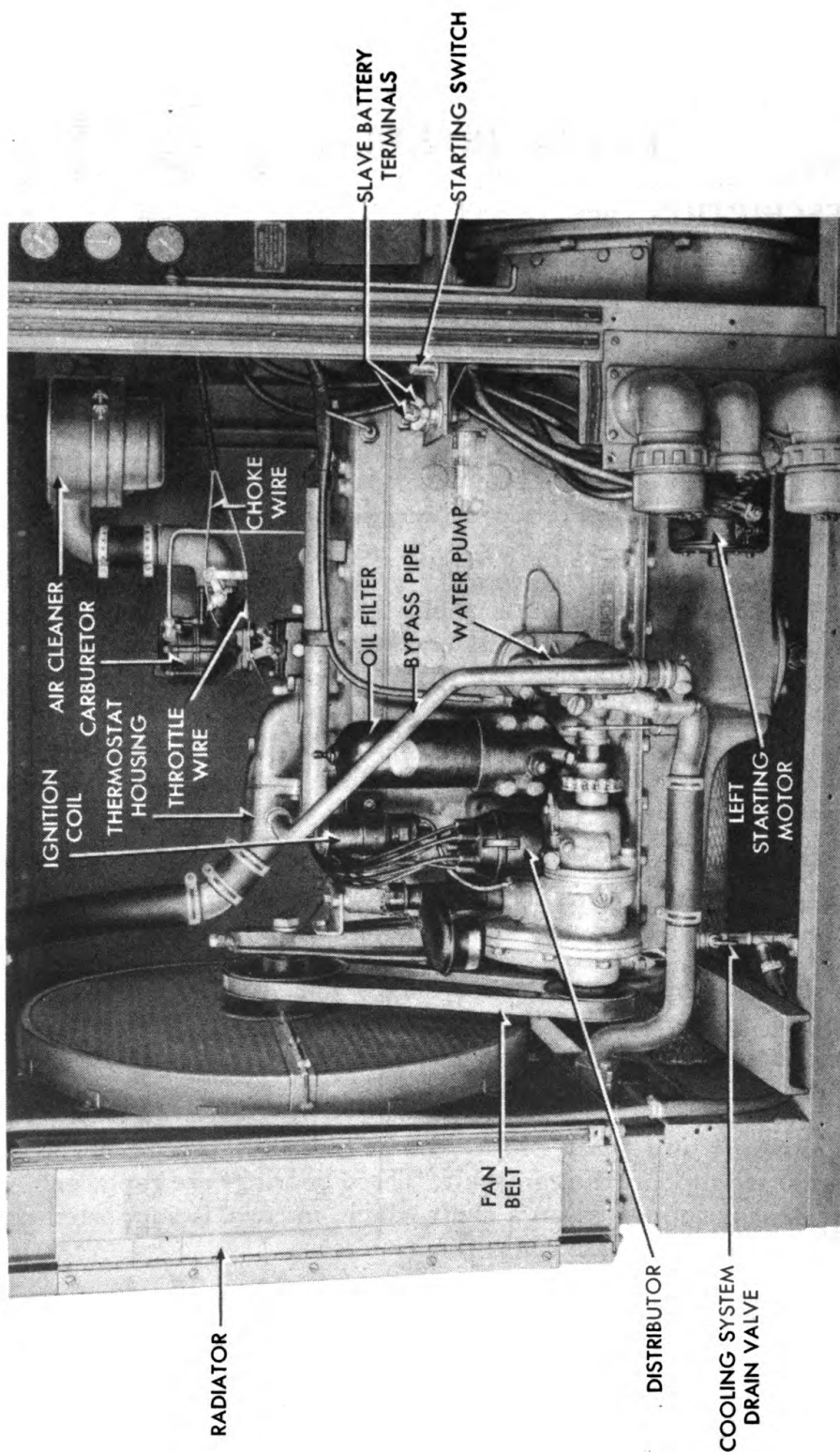
c. **Valves.** Removable valve guides are pressed into the cylinder block. Valve tappets are of mushroom type and are guided in removable clusters bolted to the crankcase. Replaceable exhaust valve seat inserts are used.

d. **Camshaft and Idler Shaft.** Large-diameter bronze bearings in the crankcase support the camshaft. These bearings are replaceable. The idler gear is supported on a shaft which, in turn, is supported on a removable bushing pressed into the crankcase.

e. **Manifold.** An intake and exhaust manifold of iron is cast in one piece. Exhaust gases pass through a space which surrounds the intake manifold.

f. **Water Pump Drive.** A water pump drive (accessory drive) on the left front side of the engine is the means of driving the water pump, distributor, and fan.

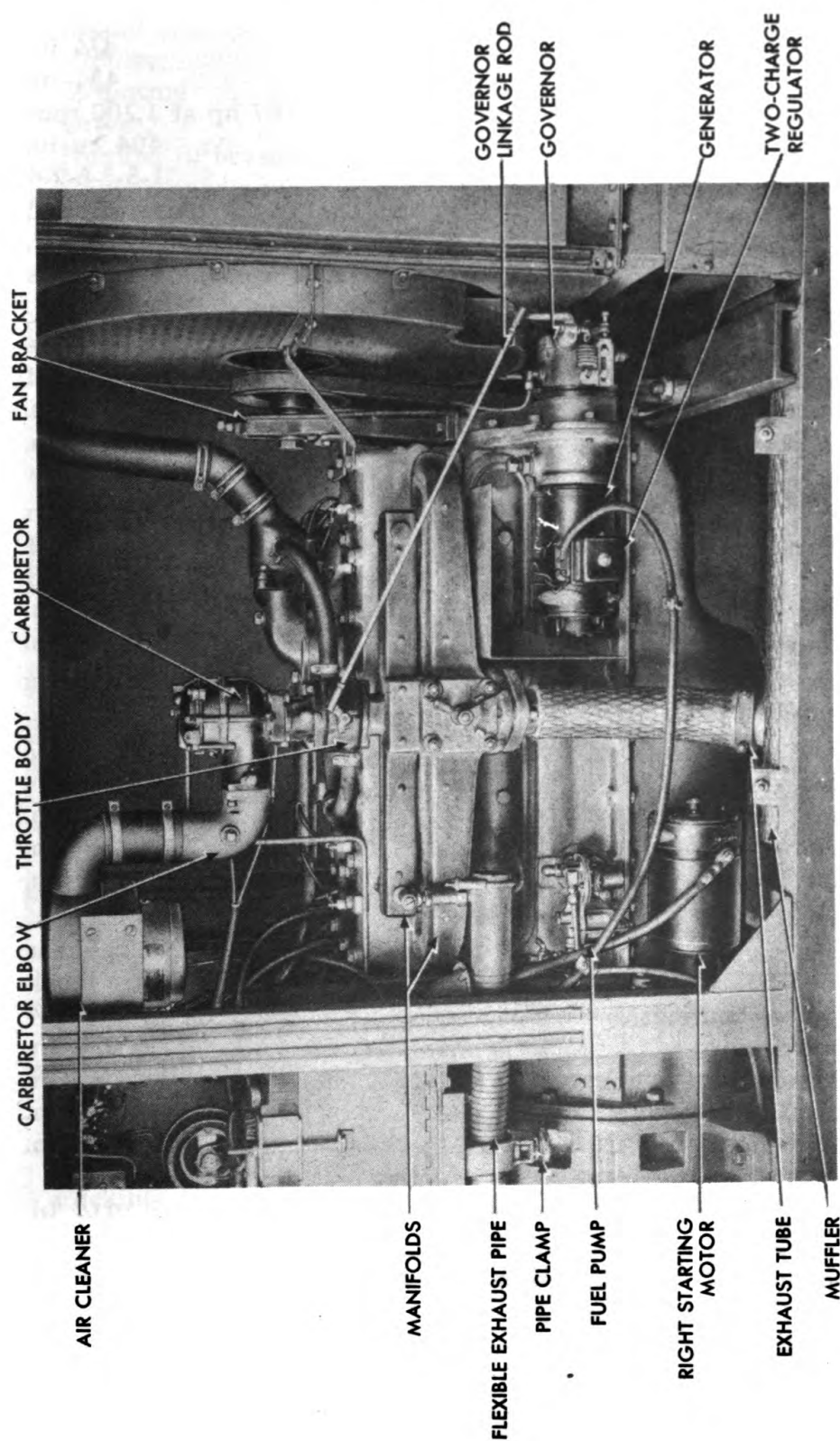
ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78102

Figure 12—Engine Installed—Left Side

ENGINE AND ACCESSORIES



RA PD 86678

Figure 13—Engine Installed—Right Side

ORDNANCE MAINTENANCE—GENERATING UNIT M18

Governor:

Manufacturer King Seeley Corp.
 Model King Seeley, 26765-323
 Type Mechanical, flyball
 Setting 1,200 rpm

Fuel pump:

Model A-C, 1537763
 Type Diaphragm, with sediment bowl

Fuel lines:

Material Copper
 Outside diameter $\frac{5}{16}$ in.
 Length (tank to pump line) $48\frac{13}{16}$ in.
 Length (pump to carburetor line) $43\frac{5}{16}$ in.
 Fittings Flared tube nut

Oil strainer:

Model Hercules, 18145-BS
 Type Wire mesh

Oil filter:

Model Michiana, HW
 Type Felt pad

Oil pump:

Model Hercules, 18126-CS
 Type Submerged, spur gear

Ignition coil:

Model Auto-Lite, CM406
 Voltage 12

Distributor:

Model Auto-Lite, IGZ-4101M
 Type Automatic advance
 Rotation Clockwise (viewed from top)
 Point gap (max.) 0.020 in.
 Breaker arm spring tension 12 to 17 oz

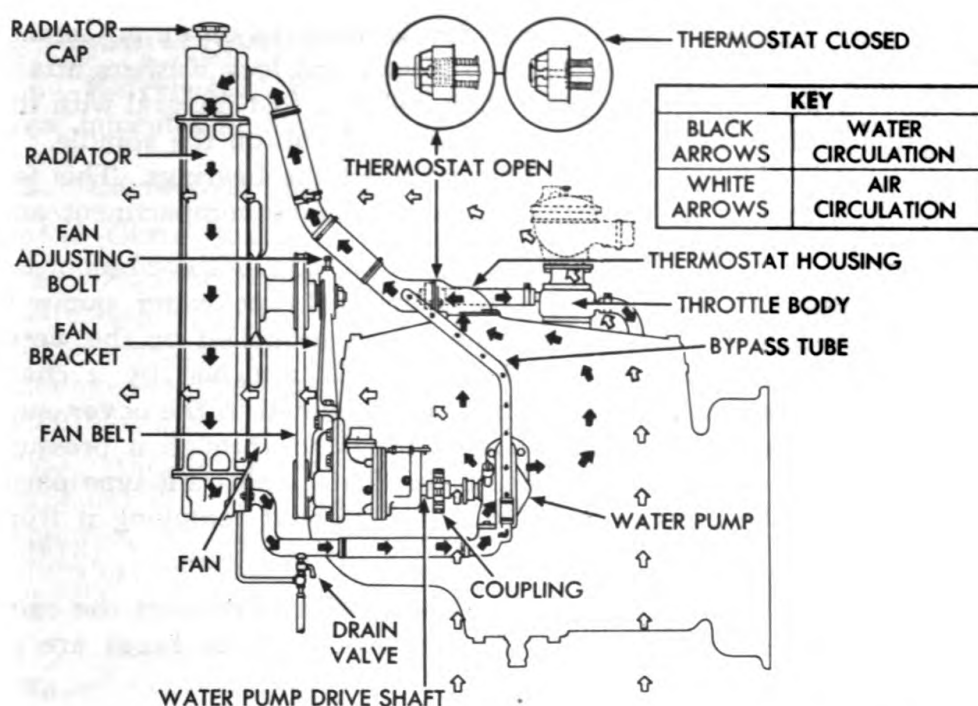
 Section II

COOLING SYSTEM

26. DESCRIPTION AND CONSTRUCTION.

a. General (fig. 14). The cooling system consists of a radiator, fan, water pump, thermostat, water passages in the cylinder block and head, and connections between these units. It has a capacity of 36 quarts. In addition, coolant is drawn from the system to the throttle body by hoses attached to fittings on the throttle housing and cylinder head. The purpose of running coolant through the throttle body is to prevent the butterfly valve from freezing in any position during cold-

ENGINE AND ACCESSORIES



RA PD 78550

Figure 14—Cooling System Diagram

weather operation. The function of the cooling system is to maintain an efficient operating temperature for the engine. Water, or other coolant, is cooled in the radiator by air forced through the core by the fan. The cooled water is drawn from the bottom of the radiator by the pump and forced through the water passages in the engine to the top of the radiator. While in the engine, the water absorbs heat and cools the engine. When the engine is cold, the thermostat remains closed. This shuts off the water from the radiator, and forces it to go directly from the top of the engine to the bottom of the water pump by way of the bypass tube. As the water increases in temperature, the thermostat opens and permits circulation from the engine to the radiator.

b. **Radiator** (fig. 14). A heavy-duty tractor-type radiator is used. It consists of a core, upper and lower tanks, and a fan shroud. Copper tubes and fins compose the core. Upper and lower tanks are made of welded sheet steel, and are bolted to the core. Six long steel rods tie the two tanks together in front of the core. They also serve to protect the core from external damage. A steel overflow tube is welded into the upper tank and extends down the rear left side of the core to the bottom of the radiator. A sheet steel fan shroud covers the rear of the core and is attached to the radiator side members with screws and lock washers.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

c. **Fan** (fig. 14). A six-bladed fan is mounted on an adjustable bracket behind the radiator. Six cap screws and lock washers attach the blade assembly to a machined hub which is cast integral with the belt pulley. Two roller bearings support the hub on the spindle. A grease plug in the hub permits lubrication of the bearings. This fan is a pusher type; it draws air through the engine compartment and pushes it out through the radiator core.

d. **Water Pump** (fig. 14). A centrifugal-type water pump is mounted on the left side of the engine. It is propelled by the water pump drive (accessory drive) to which it is attached by a chain coupling. A bronze babbitt-lined bushing, mounted in the cover, supports the pump shaft. Lubrication is provided through a pressure grease cup. The impeller is keyed to the shaft. Split-ring type packing is used so the pump can be repacked without removing it from the engine.

e. **Hoses.** Various size hoses are used to interconnect the components of the cooling system. Dimensions of these hoses are as follows:

Upper radiator long hose:

Inside diameter	2 in.
Length	12 in.

Upper radiator short hose:

Inside diameter	2 in.
Length	3 in.

Lower radiator hose:

Inside diameter	1½ in.
Length	8 in.

Bypass tube hoses:

Number used	2
Inside diameter	1 in.
Length	2¼ in.

Throttle body front hose:

Inside diameter	1⅛ in.
Length	12 in.

Throttle body rear hose:

Inside diameter	1⅛ in.
Length	8 in.

Radiator to tee drain hose:

Inside diameter	½ in.
Length	16 in.

Drain hose:

Inside diameter	½ in.
Length	7 in.

ENGINE AND ACCESSORIES**27. MAINTENANCE.**

a. **Reference.** For daily inspection, periodic inspection, anti-freeze information, and cleaning instructions, refer to TM 9-617.

b. **Corrective Service.**

(1) **CLEANING.**

(a) Run the engine, radiator covered if necessary, until temperature reaches operating range. Stop engine, remove radiator cap, and drain system by opening drain cocks in radiator and block. Coolants containing ethylene glycol will be saved or discarded as outlined WD Circular No. 137, Section V, dated 16 June 1943.

(b) Allow engine to cool, close drain cocks, and pour the cleaning compound (Federal Stock No. 51-C-1568-500) into radiator in the amount of two cans to every 4 gallons of cooling system capacity. Fill system with water. Do not spill solution on paint. Place a clean drain pan to collect overflow and use to maintain level in radiator.

(c) Replace radiator cap and run engine at moderate speed, covering radiator if necessary, so that radiator core reaches a temperature of 180°F or higher, but not allow solution to boil. Run engine at this temperature for at least 2 hours. Stop the engine as often as necessary to prevent boiling.

(d) With the engine stopped, feel the radiator core with bare hand for cold spots, and watch temperature indicator. When there is no change in temperature for some time, drain the cleaning solution.

(e) If clogging of core is relieved but not fully corrected, allow engine to cool, pressure-flush the system (step (3), below) and repeat cleaning operation.

(f) If clogging of core, indicated by low-temperature spots on core, is not relieved, radiator core must be removed for mechanical cleaning. Mechanical cleaning may be accomplished by removing upper and lower tanks and rodding out the accumulated rust and scale from the water passages of the core.

(2) **NEUTRALIZING.**

(a) Allow engine to cool, close drain cocks, and pour neutralizer compound (Federal Stock No. 51-C-1568-500) into radiator in the amount of two cans to every 4 gallons of cooling system capacity. Fill system with water.

(b) Run engine, radiator covered if necessary, until solution is up to operating temperature.

(c) Drain by removing cap and opening all drains.

(3) **FLUSHING (PRESSURE).**

(a) Remove thermostat and hose connecting the engine block and radiator core.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(b) Clamp a convenient length of hose to radiator core outlet opening, and attach another suitable length of hose to radiator inlet opening to carry away flushing stream.

(c) Connect the flushing gun 40-G-540 to compressed air and water pressure, and clamp nozzle of gun in the hose attached to the radiator outlet opening.

(d) With radiator cap on tight, fill core with water. Turn on air pressure in short blasts to prevent core damage. Allow radiator to fill with water, and again apply air pressure as before. Repeat this process until water comes out clear.

(e) Clamp flushing gun nozzle firmly to a hose attached to engine water outlet opening. Fill engine with water. Turn on compressed air to blow out water and loosen sediment. Repeat filling with water and blowing out with air until flushing stream is clear.

(f) For badly clogged engine water jackets that do not respond to regular pressure flushing, remove cylinder head studs, accessible water jacket covers or core hole plugs and, with a suitable length of small copper tubing attached to flushing gun nozzle, flush jackets through those openings.

(g) After completing the flushing operation and before connecting cooling system hose, clean off all water connections of both radiator and engine block. Clean out radiator overflow pipe, inspect, and, if necessary, lubricate water pump, and clean thermostat. Blow insects and dirt from radiator core passages, using water if necessary to soften obstructions.

(4) LEAKS.

(a) After completing the flushing operation and before pouring the proper coolant in the cooling system, the entire cooling system must be examined for leaks. This is important because the cleaning solution uncovers leaks already existing but plugged with rust or corrosion.

(b) Correct all leaks found, to avoid foaming, loss of solution, and corrosion. Check tightness of cylinder head joint, using torque indicating wrench.

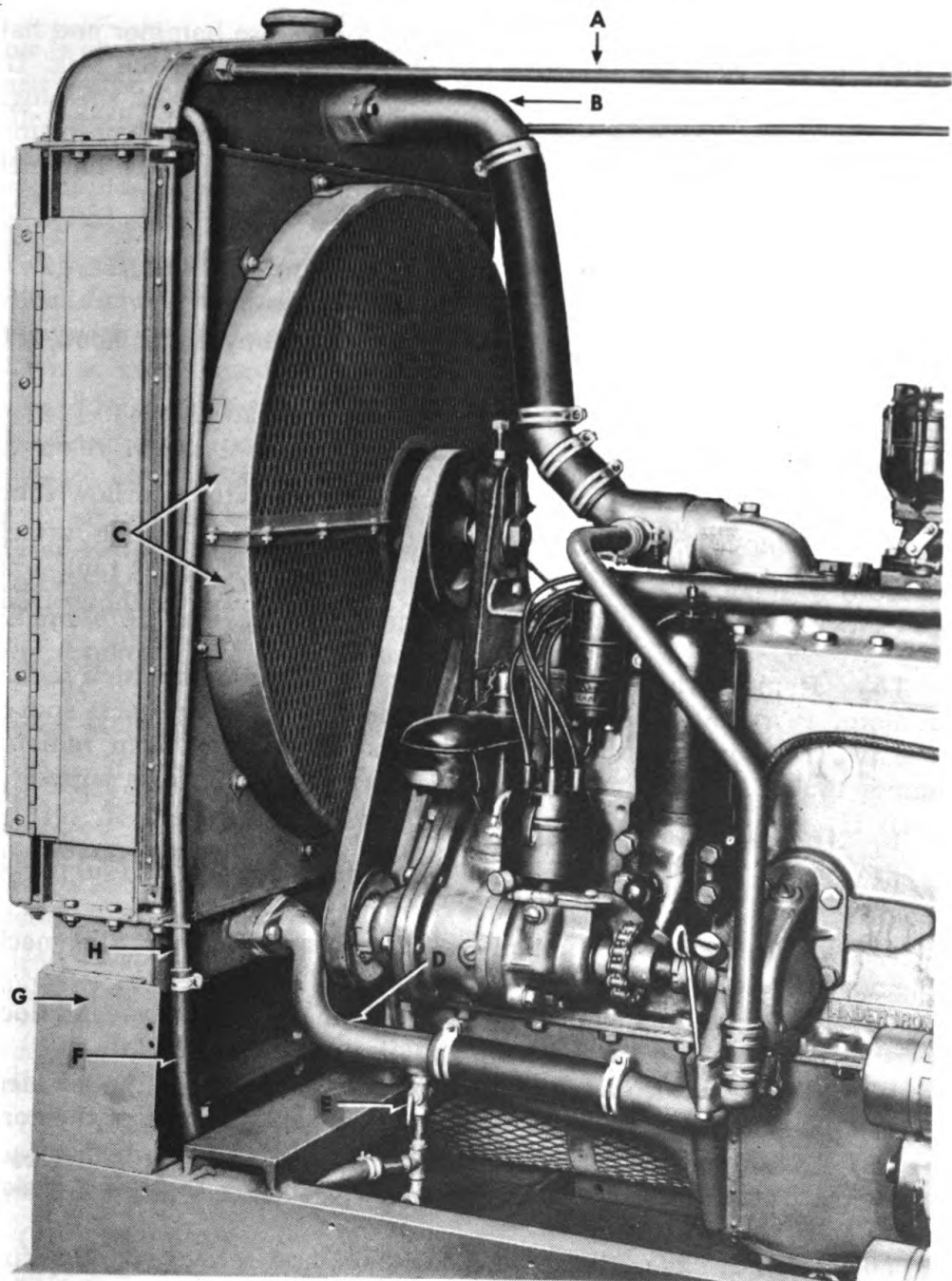
(5) COOLANT SERVICE.

(a) When servicing for summer, refill system with clean water and add rust inhibitor (Federal Stock No. 51-C-1600). Use one container of inhibitor to each 4 gallons of cooling system capacity.

(b) When servicing for winter, refill system with clean water and with sufficient antifreeze for protection against lowest temperature likely to be encountered.

c. **Pre-disassembly Engine Maintenance.** The cooling system should be flushed before the engine is disassembled. Check the plugs

ENGINE AND ACCESSORIES



- A—RADIATOR TIE ROD
- B—RADIATOR INLET ELBOW
- C—FAN GUARD
- D—RADIATOR OUTLET ELBOW
- E—DRAIN VALVE
- F—RADIATOR TO TEE HOSE
- G—RADIATOR BASE SUPPORT
- H—OVERFLOW TUBE

RA PD 78606

Figure 15—Radiator Removal Points

ORDNANCE MAINTENANCE—GENERATING UNIT M18

in the water jacket for leaks. If leaks are found, use hammer and flat punch, 1/2-face or larger, to drive the plug at the point of the leak. If, when reverse-flushing the system, too much pressure is used, the plugs may blow out. If this happens, put joint and thread compound (cement type B) around the seat, and drive in new plug with hammer and punch.

28. RADIATOR.**a. Removal (fig. 15).**

(1) Remove canopy front side panels, all canopy doors, hood, and radiator doors.

(2) Remove fan guard.

(3) Drain cooling system.

(4) Disconnect radiator to tee hose from radiator overflow tube.

(5) Remove two cap screws and lock washers which attach radiator inlet elbow to radiator. Pull elbow free of upper tank, and remove gasket. Similarly disconnect radiator outlet elbow from lower tank.

(6) Remove the four cap screws and lock washers which secure radiator to radiator base support. Loosen lock nut on each end of the two horizontal radiator tie rods, and screw rods from radiator upper tank. Lift radiator and two pieces of webbing from support.

b. Disassembly (fig. 16).

(1) Test radiator for leakage before disassembling it (subpar. c, below).

(2) Turn radiator cap counterclockwise and lift from filler neck. Remove screw which attaches chain to cap.

(3) Remove the eight shroud-to-side-member screws and lock washers, and lift fan shroud from radiator.

(4) Remove nut and lock washer from each end of the six steel rods which extend from upper tank to lower tank in front of the core.

(5) Remove the 28 nuts, lock washers, and screws which attach upper tank to core and side members. Lift upper tank and gasket from core and side members.

(6) Remove the 28 nuts, lock washers, and screws which secure lower tank to core and side members. Lift lower tank, gasket, and the two side members from core.

(7) Back off lock nuts on the six steel rods on front of core. Lift rods and upper and lower strips from core.

c. Inspection.

(1) Before disassembly, test radiator for leaks as follows: Install a water outlet elbow gasket and a metal or wooden plate (screw holes drilled 3 5/8 inches apart) over water outlet elbow opening in

ENGINE AND ACCESSORIES

lower tank. Attach a similar plate equipped with an air inlet valve over water inlet elbow in upper tank. Install filler cap securely on filler neck. Plug overflow tube. Submerge radiator in water and apply a maximum of 5 pounds air pressure to radiator. Watch for air bubbles which indicate leaks. **CAUTION:** *Do not use pressure in excess of 5 pounds.*

(2) After disassembly, clean radiator large parts with soap and water. Scrape residue from interior of tanks. Blow residue from core tubes with compressed air. Blow dirt from core fins with an air blast. Clean screws, nuts, and lock washers with dry-cleaning solvent.

(3) Test fit of filler cap on filler neck. Inspect tanks and side members to see if dents, cracks, or loosened welds are present. Examine overflow tube, which is welded to upper tanks, to see if it is bent, kinked, or broken. Inspect core to see if any fins are bent or if soldered connections have loosened. Examine radiator door hinges, which are welded to side members, to see if they are bent or broken. Examine all screws, lock washers, strips, and rods, to see if any are bent, broken, burred, or have stripped threads.

d. Repair.

(1) If radiator cap fits loosely, bend lugs to secure snug fit.

(2) Remove dents from sheet-steel parts by bumping. If heat is used, do not heat beyond cherry red. Examine parts carefully after straightening to be sure no breaks are present. Replace badly bent sheet metal parts.

(3) Weld or replace cracked or broken sheet metal parts. Sheet steel patches may be used if necessary.

(4) Straighten core fins, if bent. Use care to keep from puncturing tubes. Solder tubes if punctured or if they have come unsoldered.

(5) Remove burs from threaded parts and from attaching surfaces with a fine mill file. Clean up damaged threads with a tap or a die. Replace broken or stripped screws, nuts, and lock washers.

(6) Replace all gaskets.

e. Assembly (fig. 16).

(1) Position upper and lower strips and the six steel rods on front of radiator core. Tighten lock nuts on rods just sufficiently to hold parts in place.

(2) Position side members on radiator core. Using a new gasket, replace lower tank in position on core and side members. Install the 28 screws, lock washers, and nuts which attach tank to core and side members.

RA PD 78181

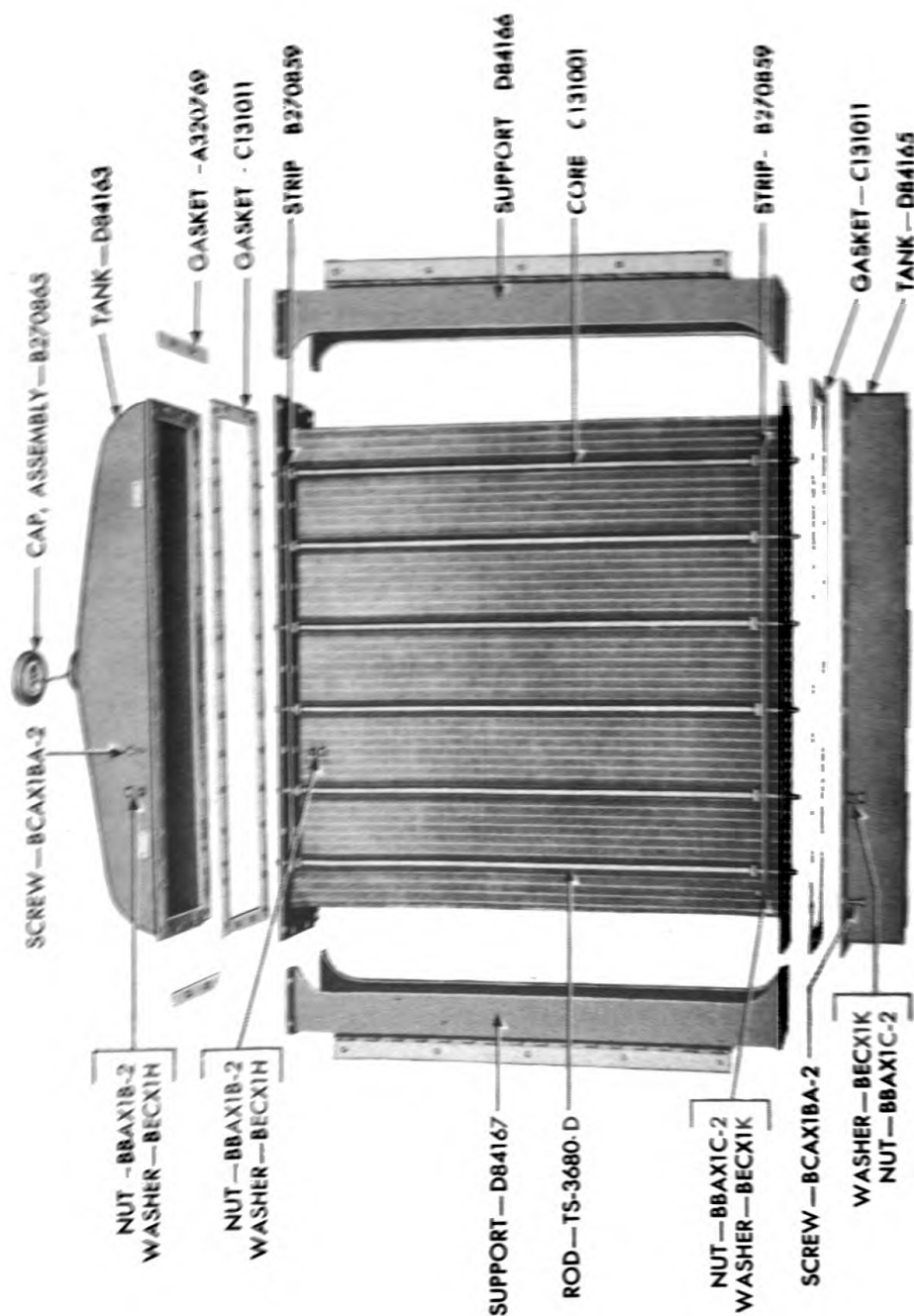


Figure 16—Radiator Disassembled

ENGINE AND ACCESSORIES

(3) Using a new gasket, position upper tank on core and side members. Install the 28 screws, lock washers, and nuts which attach tank to core and side members.

(4) Install a lock washer and nut on each end of each of the six steel rods on the front of the assembly.

(5) Position fan shroud on rear of radiator. Install the eight lock washers and shroud to side member screws.

(6) Attach chain to filler cap with screw provided for the purpose. Twist cap onto filler neck.

f. Installation (fig. 15).

(1) Position the two pieces of webbing on radiator base support. Place radiator in position on webbing. Screw the two tie rods into their bosses in radiator upper tank. Tighten tie rod lock nuts. Install the four lock nuts and cap screws which anchor radiator to base support.

(2) Using a new gasket, position radiator outlet elbow on radiator lower tank. Install the two lock washers and cap screws which attach elbow to tank. Repeat the procedure to connect radiator inlet elbow to upper tank.

(3) Connect radiator-to-tee hose to overflow tube.

(4) Fill cooling system and run engine to check radiator and connections for leaks. Tighten leaking connections and repair leaks, if any.

(5) Stop engine and install fan guard.

(6) Install radiator doors, hood, all canopy doors and front side panels.

29. FAN.

a. Disassembly (fig. 17).

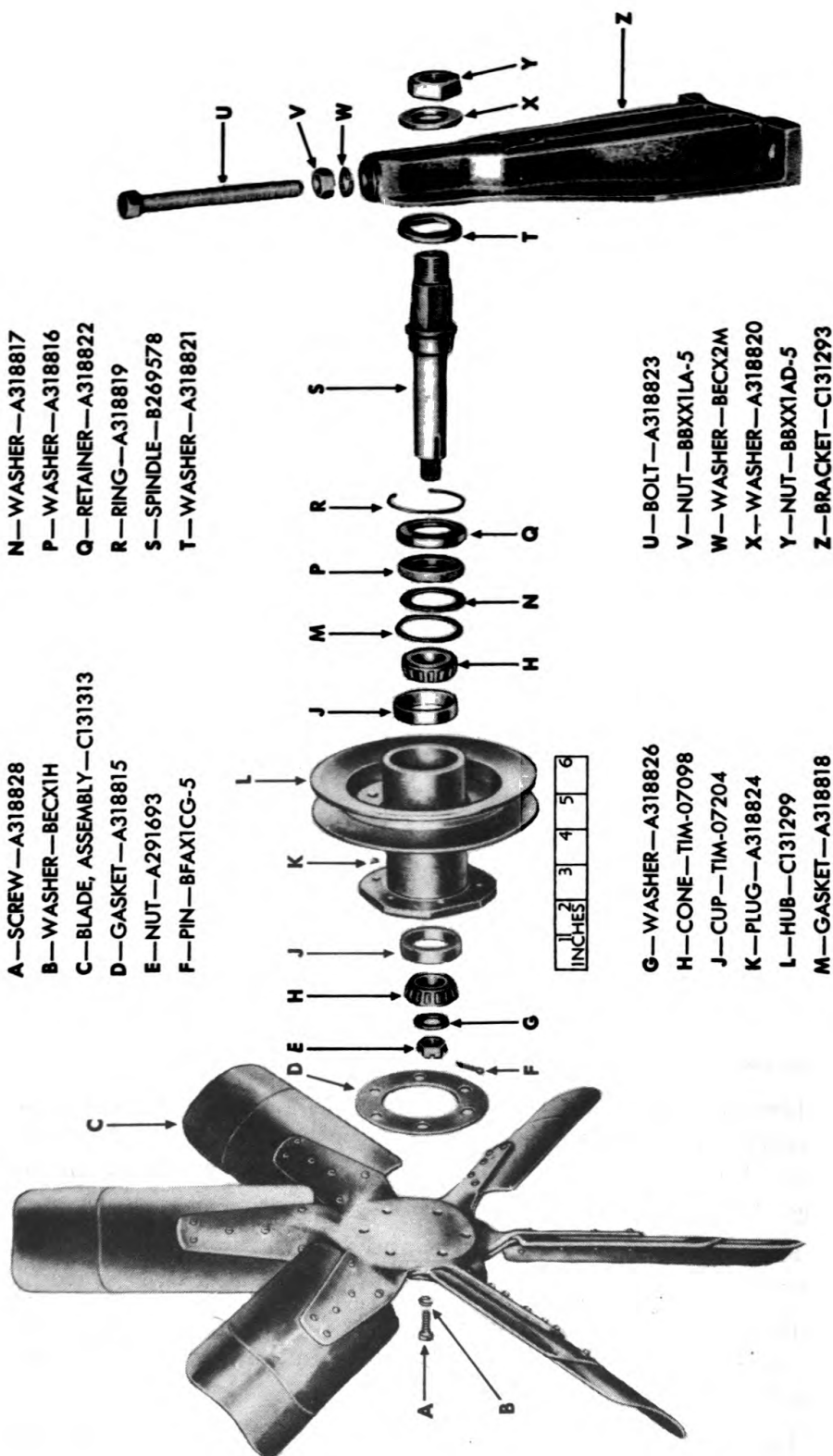
(1) Loosen lock nut on fan belt adjusting screw. Unscrew and remove adjusting screw and nut. Remove nut and washer from rear of spindle. Slide spindle from bracket. Slide special washer from rear of spindle.

(2) Remove the six cap screws and lock washers which attach blade assembly to hub. Remove blade assembly and gasket from hub.

(3) Pry snap ring from groove in rear of hub and remove cotter pin, nut, and washer from front end of spindle. Tap spindle from rear of hub.

(4) Lift bearing cone from front of hub. Tap bearing cup from seat at front and at rear of hub (two cups in two seats).

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 76223

Figure 17—Fan Disassembled

ENGINE AND ACCESSORIES

(5) Slide retainer, felt washer, steel washer, and gasket from rear of spindle. Press rear bearing from spindle.

b. Inspection.

(1) Clean all metal parts in dry-cleaning solvent, and dry with compressed air. Do not spin bearings or allow air to spin bearings.

(2) Inspect bearings and cups for evidence of scoring, chipping, or loose fit. Test fit of bearings on spindle and cups in hub.

(3) Check spindle threads for burring, or evidence of stripping. If bearing failure was the cause of disassembly, inspect spindle for evidence of scoring at point of contact with bearing race.

(4) Check fan blade assembly for loose rivets or bent blades.

(5) Inspect hub and bracket to see if either is cracked or broken. In case of bearing failure, inspect bearing cup seats for scoring.

(6) Inspect nuts, screws, washers, snap ring, and retainer to see if they are bent or broken. Note condition of threads on threaded parts.

c. Repair. Replace fan assembly if unrepairable.

d. Assembly (fig. 17).

(1) Press front and rear bearing cups to their seats in hub. Pack bearings with general purpose grease (No. 2) and position bearings in cups.

(2) In order named, install gasket, steel washer, felt washer, retainer, and snap ring in recess in rear of hub.

(3) Insert spindle through hub from rear. Install washer and nut on front end of spindle. Tighten nut sufficiently to eliminate side play but not tight enough to interfere with free rotation. Install cotter pin.

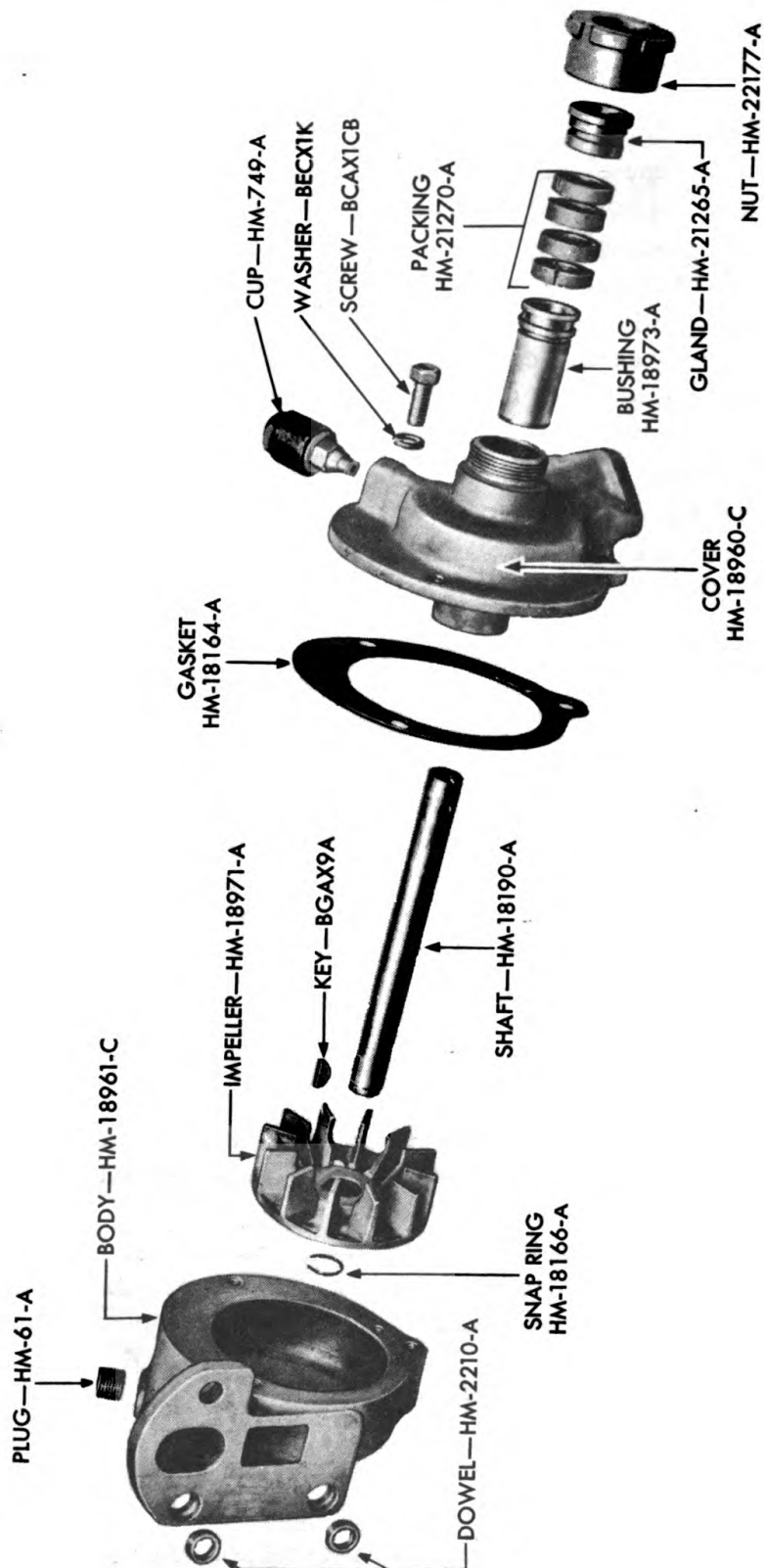
(4) Position blade gasket and blade assembly on front of hub. Install the six lock washers and cap screws which attach blade assembly to hub.

(5) Position special washer on rear of spindle and insert rear of spindle into bracket. Install flat washer and nut on rear of spindle. Screw lock nut onto adjusting screw, slide lock washer onto screw, and screw adjusting screw into top of bracket. Do not tighten nut until fan belt adjustment is made after installation.

30. WATER PUMP.**a. Disassembly (fig. 18).**

(1) Drive out pin which attaches coupling sprocket to shaft, and press sprocket from shaft.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 46442

Figure 18—Water Pump Disassembled

ENGINE AND ACCESSORIES

(2) Remove the three cap screws and lock washers which attach cover to body. Lift cover and gasket from body. Screw grease cup and packing nut from cover. Remove gland, packing, and impeller back off shaft. Remove key from shaft.

(3) Press impeller down onto shaft and remove snap ring. Press impeller back off shaft. Remove key from shaft.

(4) Tap dowels from base screw holes. Unscrew plug and drain cock from body.

b. Inspection.

(1) Wash all metal parts with dry-cleaning solvent, and dry with compressed air.

(2) Inspect body and cover for cracks.

(3) Test fit of impeller on shaft. It should be a press fit. Inspect impeller to be sure no fins are broken. Examine keyway on shaft to see if it is burred or spread.

(4) Test fit of shaft in bushing. No perceptible side play is permissible. Inspect shaft and bushing to see if either is scored.

(5) Inspect screws, dowels, washers, plug, snap ring, key, and gland to see if any are bent, broken, burred, or if threads (on threaded parts) are damaged.

c. Repair.

(1) Clean burs from all parts with a fine mill file. Clean up damaged threads with a tap or a die.

(2) Replace broken worn, or bent parts. Replace all gaskets and packing. Replace water pump assembly, if unrepairable.

d. Assembly (fig. 18).

(1) Tap key to seat in keyway in shaft. Press impeller onto shaft and key far enough to permit installation of snap ring. Install snap ring on shaft and press impeller back on shaft until it seats against snap ring.

(2) Press shaft bushing in cover to stop. Insert impeller shaft into position through bushing in cover. Install four rings of new packing, the gland, and packing nut.

(3) Position body on cover, using new gasket, and install the three lock washers and cap screws which attach the parts.

(4) Install grease cup in its boss on cover.

(5) Screw plug and drain cock into their respective bosses on body. Tap dowels to seat in base screw holes.

(6) Tap coupling sprocket onto end of shaft with pinholes in sprocket and shaft alined. Drive pin into pinhole and peen pin.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

Section III

FUEL SYSTEM

31. DESCRIPTION.

a. **General** (figs. 19 and 20). The fuel system consists of a carburetor, air cleaner, throttle body, governor, fuel pump, gasoline tank, and necessary controls and lines. In operation, the fuel pump draws gasoline from the tank and forces it to the carburetor. At the carburetor the gasoline is mixed with air and converted into vapor. Suction of the engine pistons pulls air through the air cleaner into the carburetor where it picks up the fuel vapor. The same action carries the vapor along through the intake section of the manifold into the engine cylinders.

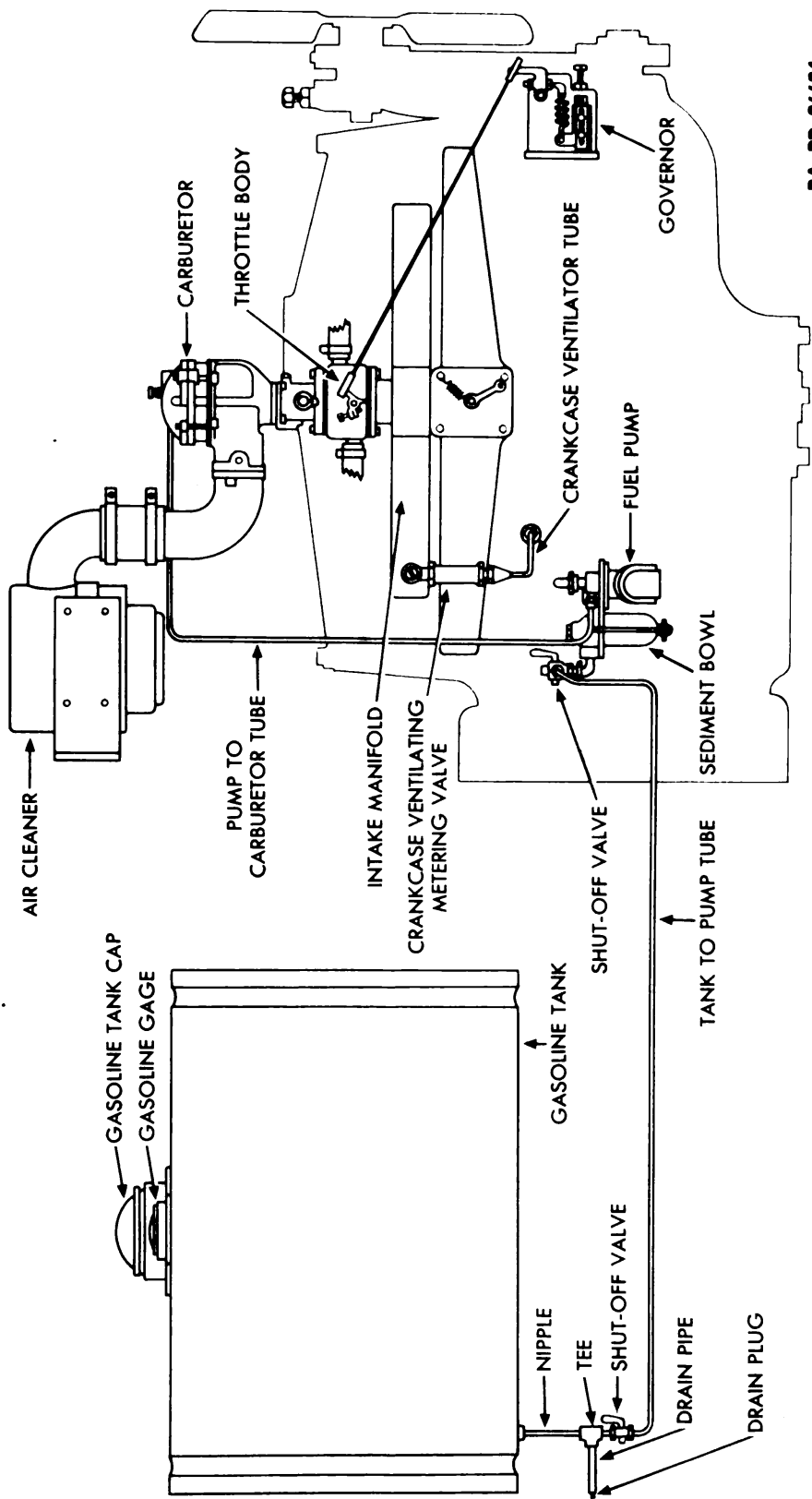
b. **Air Cleaner** (fig. 19). Abrasive impurities are removed from air entering the carburetor by the air cleaner. The air is drawn through an element of steel wool which is constantly moistened with oil vapor from the cup on the bottom of the cleaner. Dirt in the air adheres to the oil, and settles in the bottom of the cup. Except for the steel wool element, all parts of the air cleaner are made of sheet steel.

c. **Carburetor** (fig. 19). The carburetor is a downdraft type, mounted on top of the manifold. It employs a primary and a secondary venturi to aid in complete vaporization of the fuel. The carburetor is designed with a vacuum-controlled power jet and accelerating system. These auxiliary jet systems are to provide the extra fuel needed for rapid acceleration.

d. **Throttle Body** (fig. 20). The throttle body is a casting which houses a butterfly valve controlled by the governor. A water jacket is provided in the casting. Heated water from the cooling system flows through the water jacket. This feature is provided to prevent the valve from freezing in any position during extreme cold-weather operation.

e. **Governor** (fig. 20). The governor is of the centrifugal fly ball type. A spring tends to hold the throttle valve in wide-open position. The weight force, opposing the spring, tends to close the valve. The governor spring is located outside the governor case. One end is hooked to the governor lever and the other end is anchored to an adjustable bracket regulated by an adjusting screw. Increasing tension on the governor spring increases engine speed. Inside the governor the weights are hung on a weight spider which is attached to the end of the rotating drive shaft. As the weights revolve, the centrifugal force tends to throw the weights outward. The weights pivot on pins and convert the centrifugal force to a thrust against the sleeve which moves

ENGINE AND ACCESSORIES



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Figure 19—Fuel System Diagram

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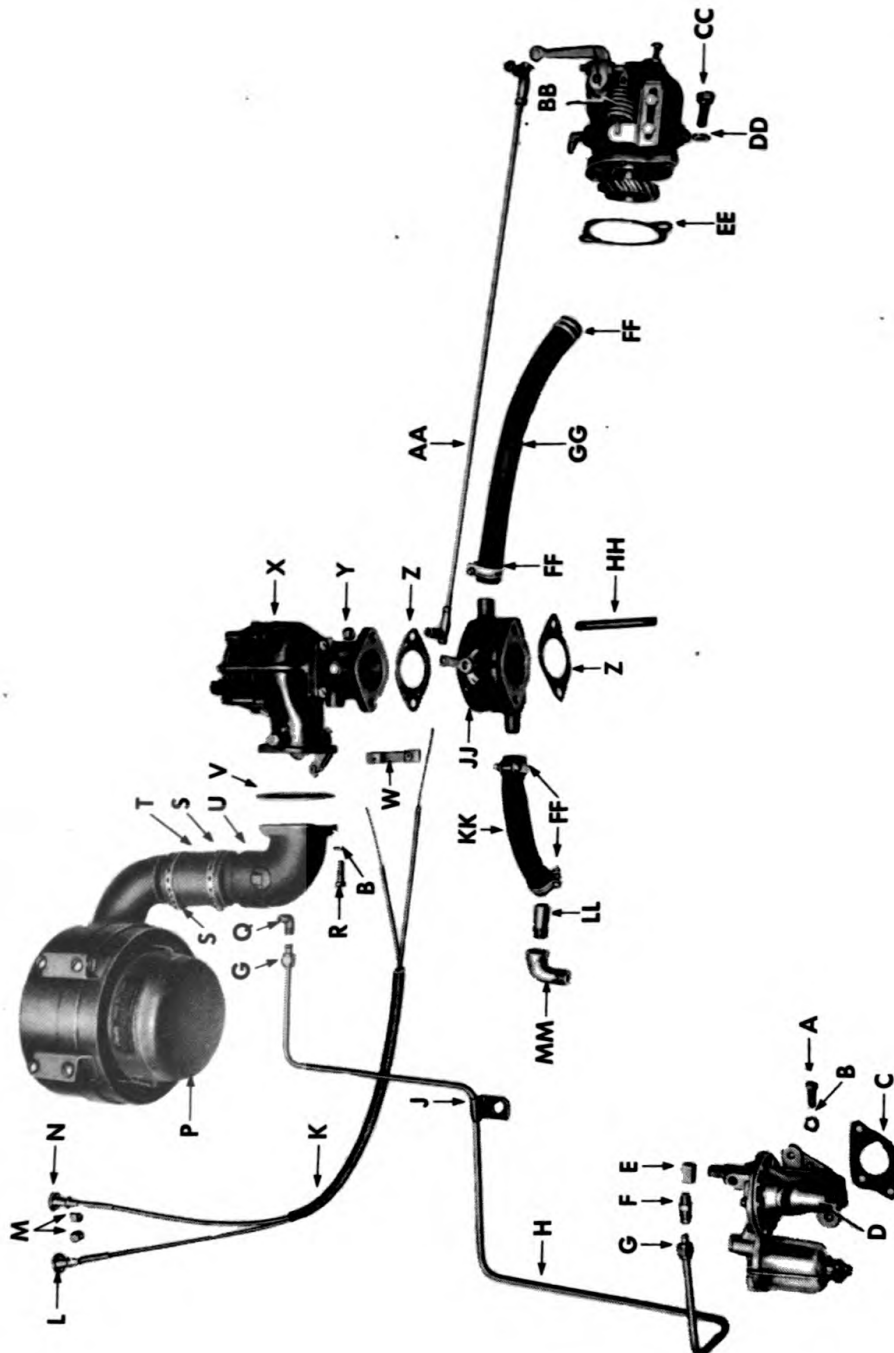


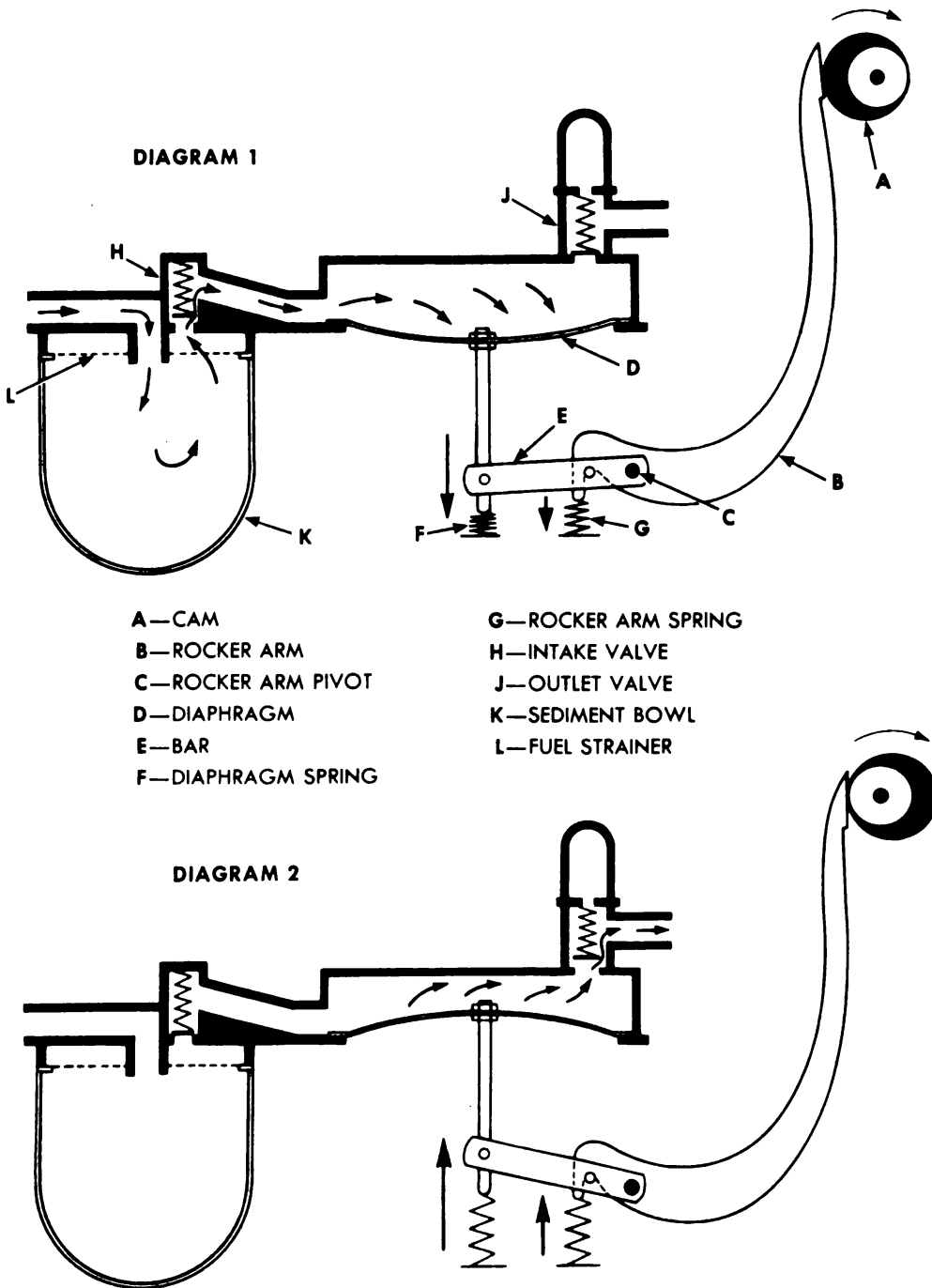
Figure 20—Fuel System Components

ENGINE AND ACCESSORIES

RA PD 78398A

A—SCREW—BCVX2CH-2	V—GASKET—A202362
B—WASHER—BECXIH	W—CLIP—B270879
C—GASKET—HM-22564-A	X—CARBURETOR, ASSEMBLY—D83533
D—PUMP, ASSEMBLY—AC-1537763	Y—NUT—88TXIFB
E—FITTING—GTS-8157	Z—GASKET—A321664
F—CONNECTOR—CNAX2AD	AA—ROD, ASSEMBLY—KS-26411
G—NUT—CNAX5BD	BB—GOVERNOR, ASSEMBLY—D83534
H—TUBE—C132078	CC—SCREW—BCVX2GL-2
J—CLIP—A321660	DD—WASHER—BECXIL
K—TUBE—A320778	EE—GASKET—HBC-35J-403
L—CONTROL—B181174	FF—CLAMP—CMA1D
M—NUT—BBSX4AC-2	GG—HOSE, RUBBER, $\frac{3}{8}$ I. D. x 1 O. D. x 12½ LONG
N—CONTROL—B181175	HH—STUD, S., $\frac{3}{8}$ -16NC-3 x 3½ LONG
P—CLEANER, ASSEMBLY—C132077	JJ—BODY, ASSEMBLY—C131383
Q—ELBOW—CNAX3AD	KK—HOSE, RUBBER, $\frac{3}{8}$ I. D. x 1 O. D. x 9 LONG
R—SCREW—BCAX1BB-2	LL—NIPPLE, PIPE, W. I., ZN-PLTD., STD., $\frac{3}{8}$ x 1½, THD. ONE END
S—CLAMP—CMA1K	MM—ELBOW—CPBX5BC
T—HOSE, RADIATOR, 2¼ I. D. x 2½ O. D. x 3¾ LONG	
U—ELBOW—B175951	

Legend for Figure 20—Fuel System Components



RA PD 79547

Figure 21—Fuel Pump Action Diagrams

ENGINE AND ACCESSORIES

longitudinally on the drive shaft. This movement is transmitted to a rocker shaft by means of a yoke which contacts the thrust bearings on the thrust sleeve. The governor lever attached to this shaft is connected to a butterfly valve in the throttle body by means of a rod. Screw-type ball and socket fittings are used on both ends of the rod. As the speed of the engine reaches the predetermined maximum, the interaction of spring and weights acts to hold the butterfly valve to the proper degree of opening. In this manner, engine speed is controlled. In actual operation, at loads within the rating of the generator, the governor maintains the speed regulation to within plus or minus 3 percent.

f. **Fuel Pump** (figs. 20 and 21). The fuel pump is a mechanical-diaphragm type operated by an eccentric on the engine camshaft. The fuel pump rocker arm is held against the eccentric on the cam by spring action. Action of the eccentric and a diaphragm spring causes the rocker arm to move back and forth. Linkage connects the rocker arm to a rod which in turn is connected to the diaphragm. Thus the motion of the rocker arm is transmitted to the diaphragm, creating a suction and pressure action which draws gasoline from the main fuel tank and forces it to the carburetor. Spring-loaded valves within the pump cover control the direction of the fuel flow.

g. **Gasoline Tank** (fig. 19). The gasoline tank is a welded sheet-steel construction. Bosses at diagonally opposite corners of the bottom of the tank are threaded to receive a fuel line fitting and pipe plug, respectively. The fuel line feeds from the lower right front corner of the tank. A filler cap is provided with a special flame arrester screen. A mechanical-type fuel gage is set into the top of the tank adjacent to the filler neck.

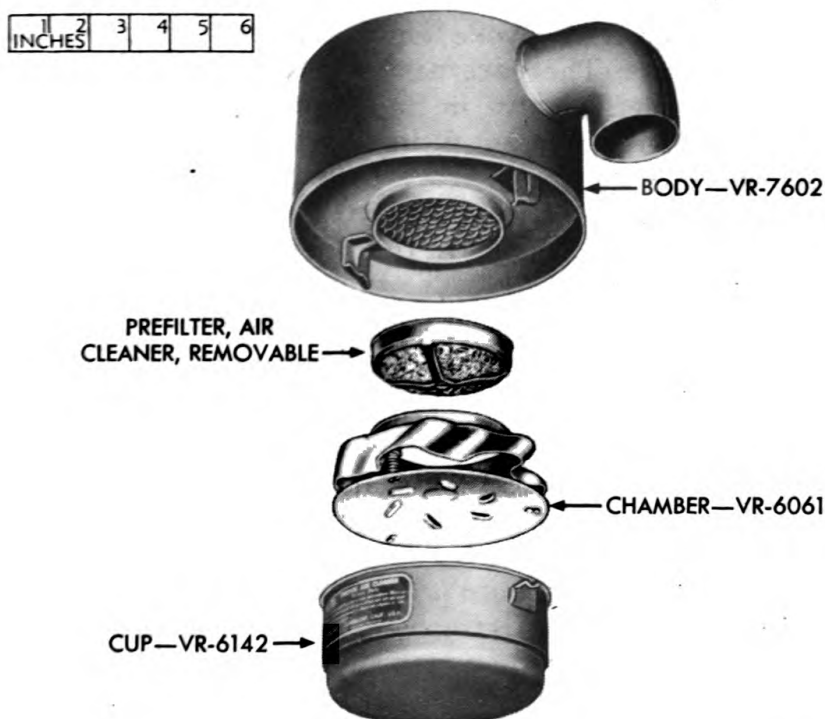
h. **Gasoline Lines and Valves** (fig. 19). Two copper gasoline lines are used. One runs from gasoline tank to fuel pump, the other from fuel pump to carburetor. Flared tube fittings are used. A drain pipe and plug are provided at the fitting where the gasoline line joins the gasoline tank. A shut-off valve is located at each end of the tank-to-pump line.

32. AIR CLEANER.

a. **Disassembly** (fig. 22). Twist oil cup counterclockwise and lift from body. Lift vortex chamber from oil cup. Pull removable pre-filter from under side of body. Remove clamp nut and bolt, and slide bracket from body. Slide the two bracket angles from bracket strap. Do not disassemble further unless necessary to make repairs. When necessary, proceed as follows:

(1) Pinch end of studs together and lift vortex chamber base and three coil springs from studs.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78413

Figure 22—Air Cleaner Disassembled

(2) Straighten the three ears which hold the two parts of the removable prefilter housing together. Separate housing and remove steel wool.

(3) Pull wire screen and steel wool from bottom of body.

b. Inspection and Repair.

(1) Clean all parts in dry-cleaning solvent, and allow to drain until dry.

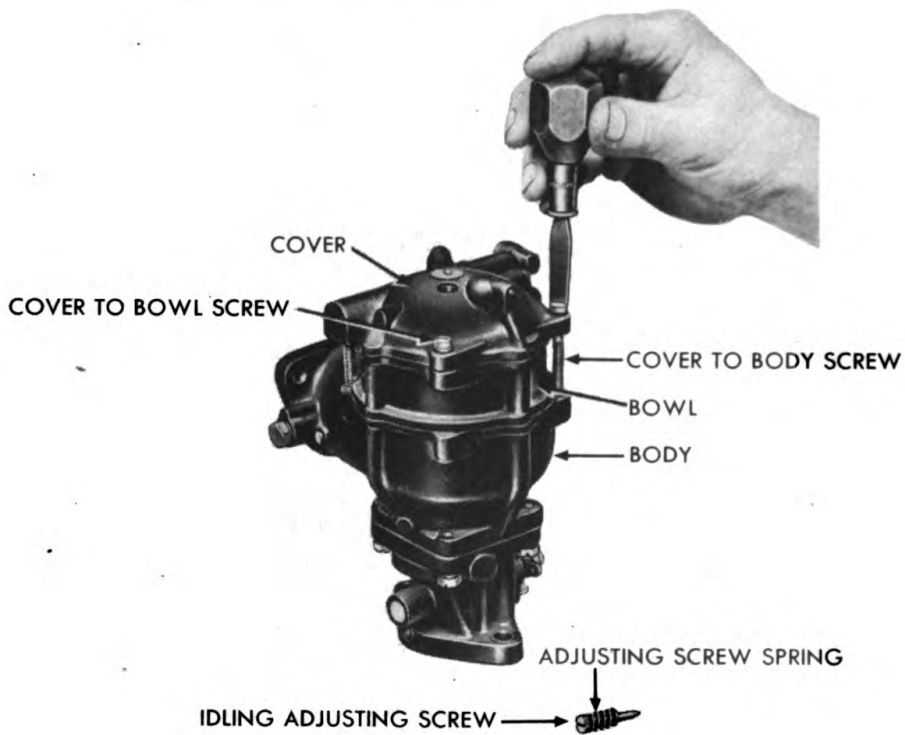
(2) Inspect sheet metal parts to see if any are bent or broken. Inspect steel wool to see if it is matted or gummy. Inspect bolts, nuts, and springs to see if any are bent or broken. Examine threads of bolts and nuts to see if any are burred or stripped.

(3) Remove dents from sheet metal parts. Replace all broken parts. Replace matted or gummy steel wool if it cannot be cleaned satisfactorily in solvent. Remove all burs with a file. Replace bolts and nuts which are stripped.

c. Assembly (fig. 22).

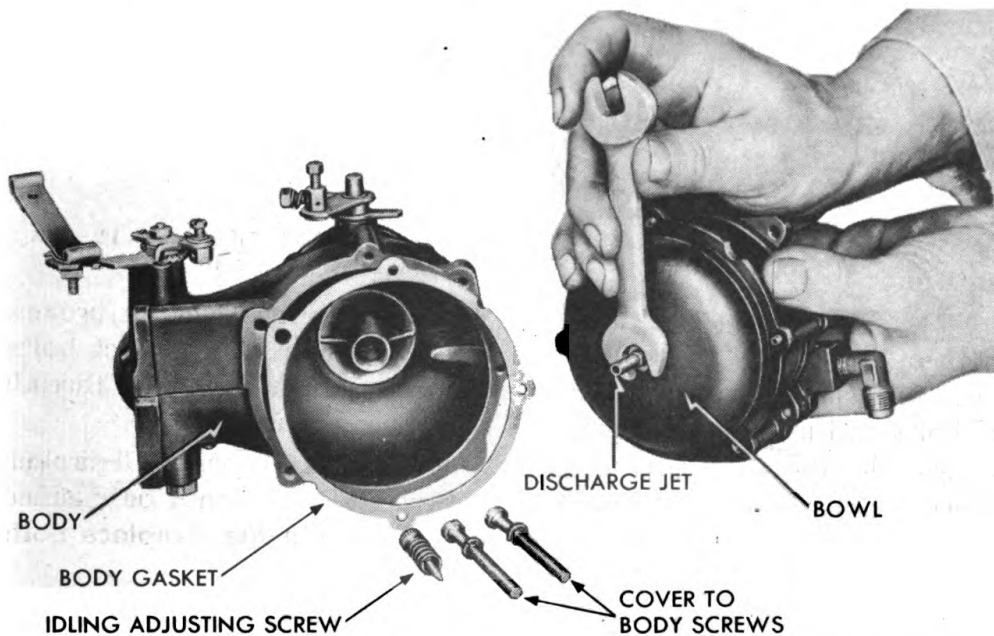
(1) Insert steel wool into body and force wire screen across inside of bottom opening.

ENGINE AND ACCESSORIES



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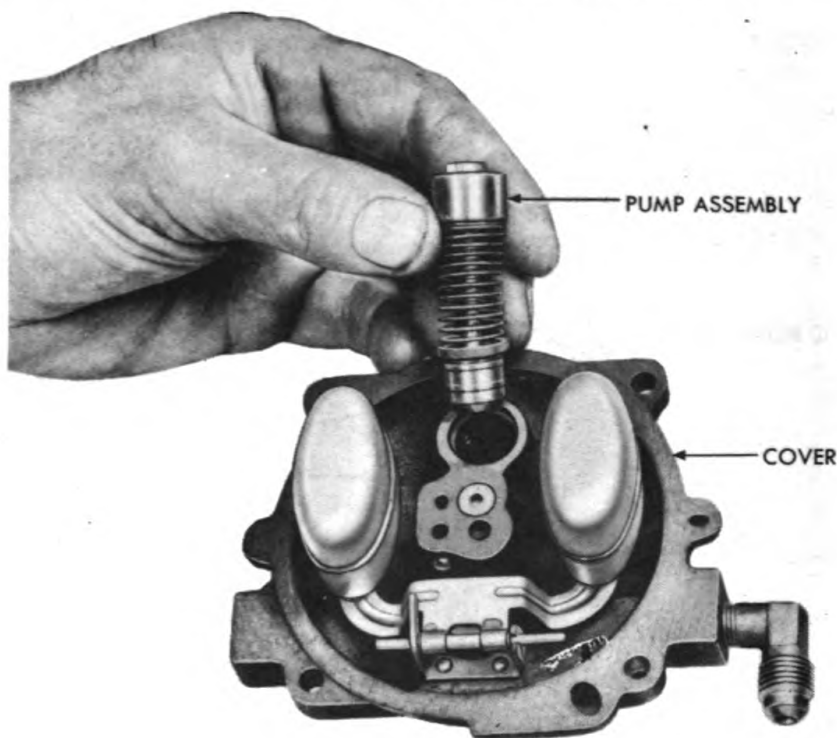
Figure 23—Carburetor Cover-to-body Screw—Removal



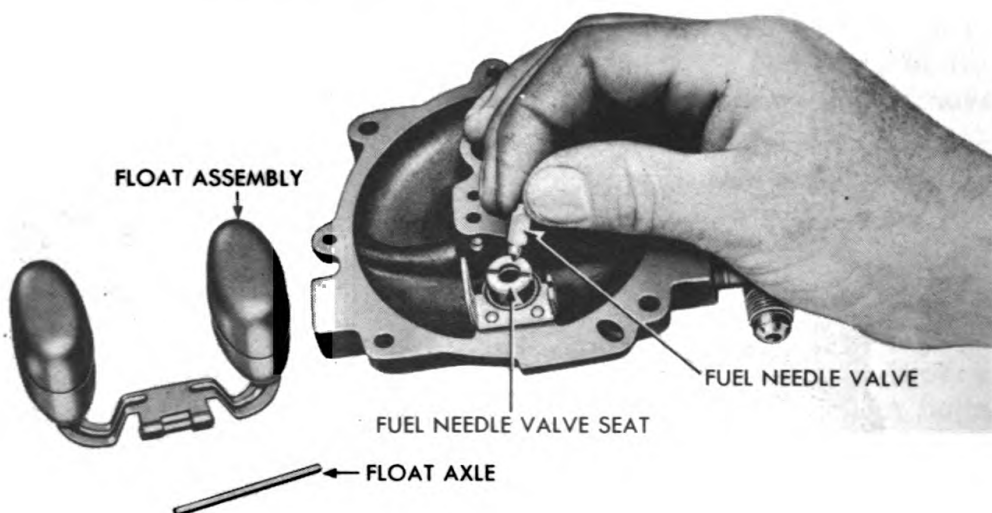
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Figure 24—Discharge Jet Removal

ORDNANCE MAINTENANCE—GENERATING UNIT M18



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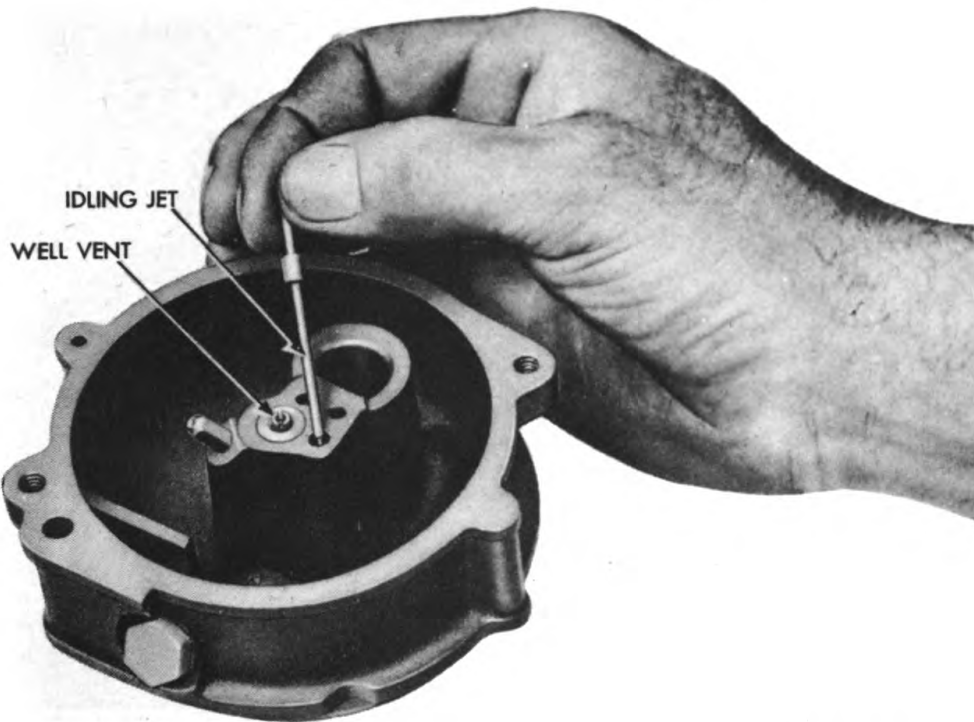
Figure 25—Pump Assembly Removal

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Figure 26—Fuel Needle Valve Removal

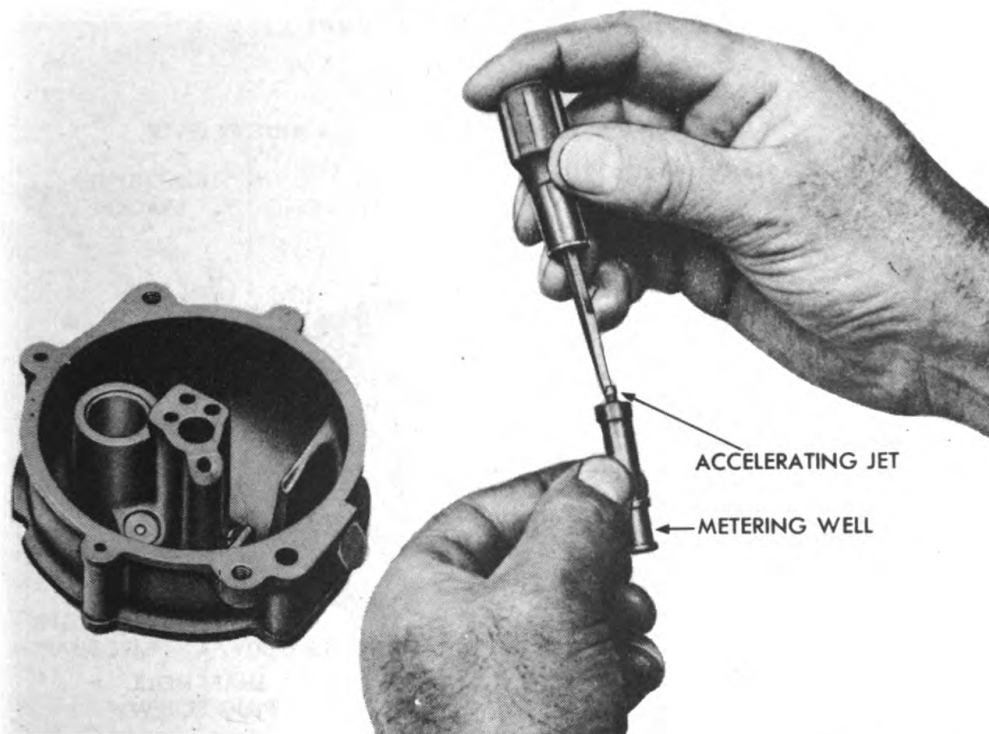
(2) Position steel wool between the halves of removable prefilter housing. Force housing together and bend over ears which hold housing together. Push prefilter into position over opening on under side of body.

ENGINE AND ACCESSORIES



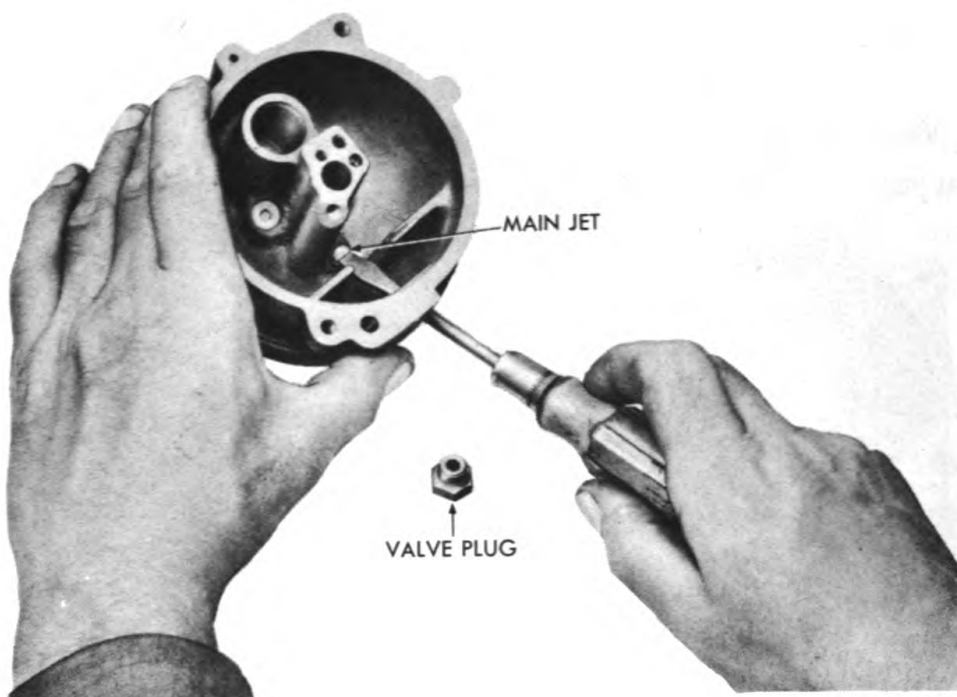
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Figure 27—Idling Jet Removal



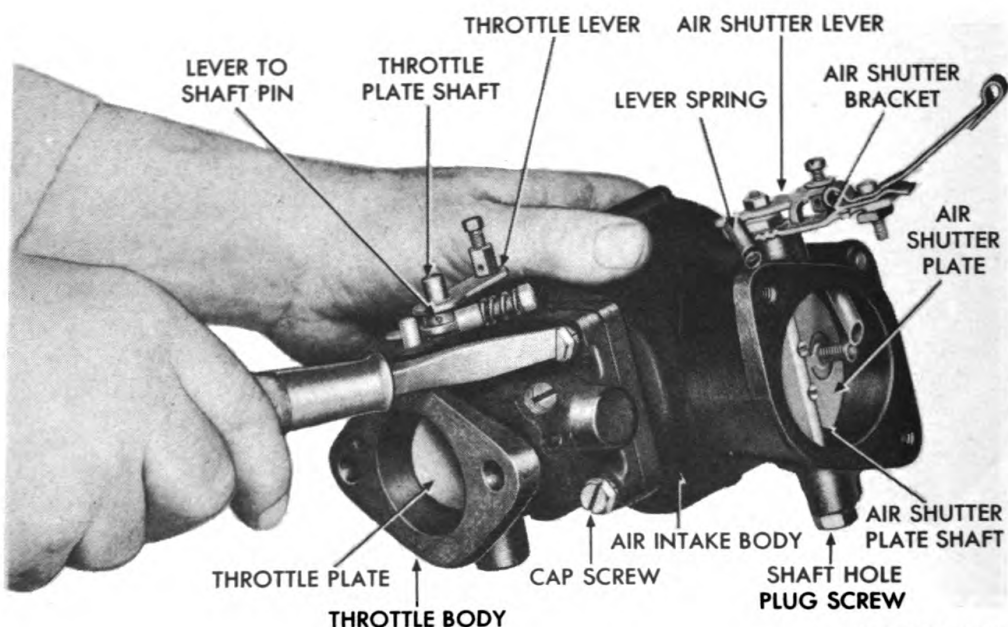
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Figure 28—Removing Accelerating Jet From Metering Well



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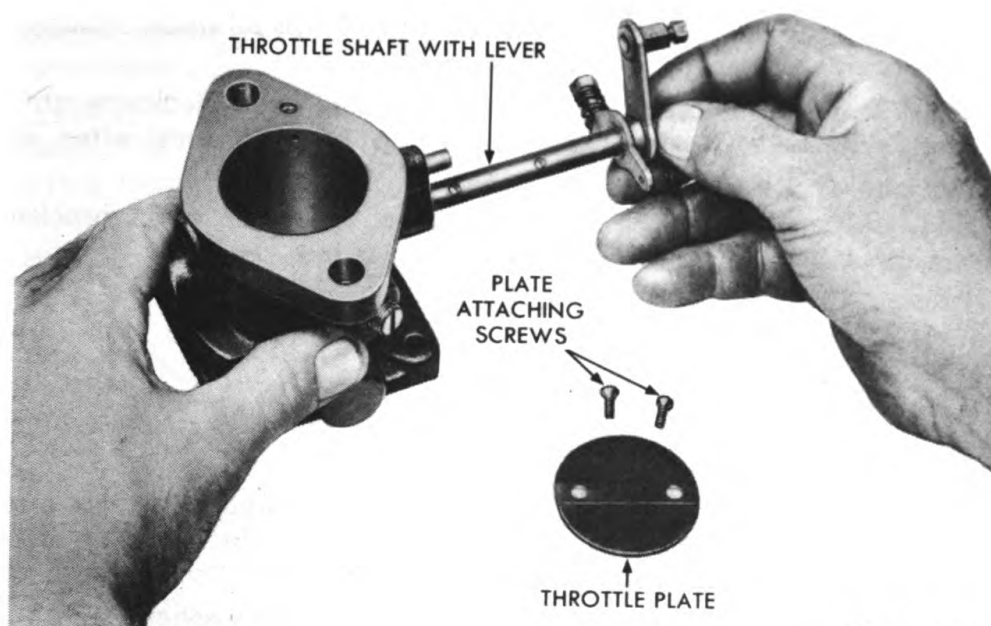
Figure 29—Main Jet Removal



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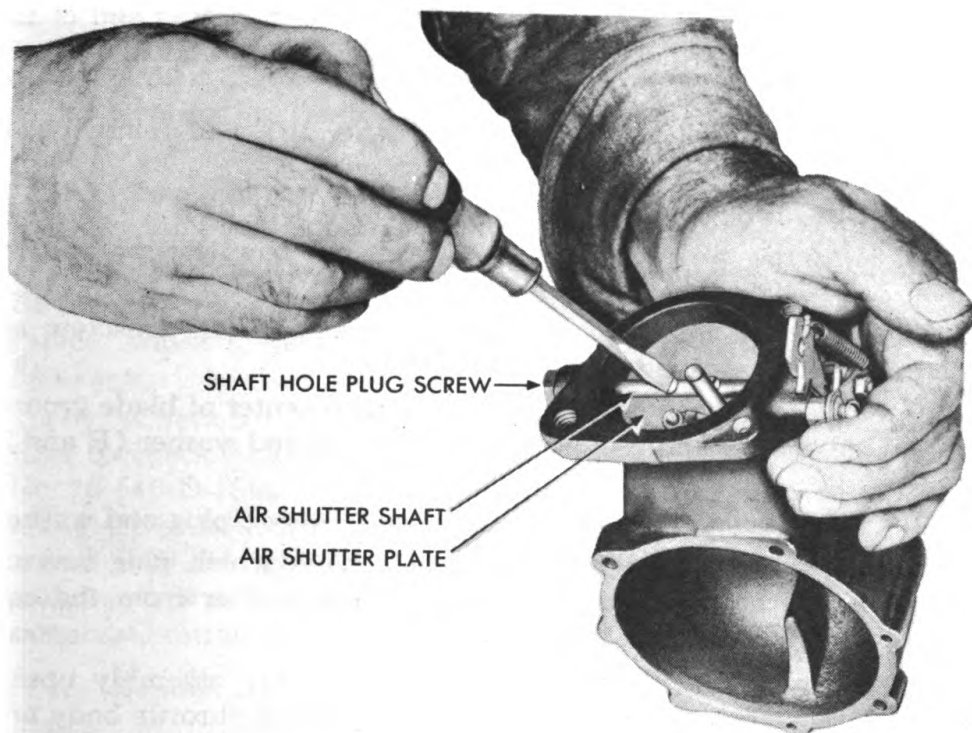
Figure 30—Throttle Body Removal

ENGINE AND ACCESSORIES



RA PD 79556

Figure 31—Throttle Shaft With Lever Removal



RA PD 79560

Figure 32—Removing Air Shutter Plate Retainer Screws

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(3) Place a coil spring on each stud on vortex chamber cover. Force base onto studs over springs and spread tips of studs. Position vortex chamber, base down, in oil cup.

(4) Position oil cup to bottom of body and twist clockwise until securely engaged. Do not service oil cup with oil until after installation.

(5) Slide bracket angles onto bracket strap. Position bracket strap about body and install clamp bolt and nut.

33. CARBURETOR.**a. Disassembly.**

(1) Unscrew idling adjusting screw at top of carburetor. Remove screw and spring (fig. 23).

(2) Take out the two long outside cover-to-body screws and washers which hold the bowl to the air intake body (fig. 23). Remove bowl, turn upside down and take off gasket.

(3) Unscrew discharge jet and remove jet and washer (fig. 24).

(4) Turn the bowl right side up and remove the two short cover-to-bowl screws and washers (fig. 34). Remove cover and gasket from bowl.

(5) Lift pump assembly out of cover (fig. 25).

(6) Push float axle (figs. 25 and 26) through slotted end of the hinge bracket and remove. Take out float assembly and fuel needle valve (fig. 26).

(7) Unscrew fuel needle valve seat (fig. 26), and remove seat and washer.

(8) Lift idling jet out of the bowl casting (fig. 27).

(9) Unscrew well vent (fig. 27) from the bowl casting and remove.

(10) Remove metering well and accelerating jet. Unscrew accelerating jet from metering well (fig. 28).

(11) Carefully center a screwdriver (with center of blade ground out) on valve head and remove power jet valve and washer (R and S, fig. 34).

(12) Unscrew valve plug (fig. 29), and remove plug and washer.

(13) Insert screwdriver through hole from which plug was removed, loosen main jet, and remove jet and washer from the carburetor (fig. 29).

(14) Turn throttle body and air intake body assembly upside down. Remove cap screws and washers connecting throttle body and air intake body (fig. 30). Remove throttle body and gasket. Lift venturi from throttle body.

ENGINE AND ACCESSORIES

(15) File off the peened ends of the screws which hold throttle plate in shaft, and remove screws. Slide plate through shaft and remove from shaft. Pull shaft with lever from body (fig. 31).

(16) Drive out pin (fig. 30) which attaches throttle lever to shaft. Slide lever from shaft. Remove the two screws and one coil spring from lever.

(17) Remove lever spring from between air shutter lever and bracket. Remove nut, washer, and lever from shaft. Remove special screw which attaches bracket to body and lift air shutter bracket (fig. 30) from body.

(18) File the peened ends of the air shutter plate retainer screws and remove the screws (fig. 32). Push air shutter plate (fig. 30) through shaft and remove. Slide shaft out of body with lever in position. Take out shaft hole plug screw and remove plug screw and washer (fig. 30).

b. Inspection.

(1) Wash all parts in dry-cleaning solvent, and dry with compressed air.

(2) Inspect bowl body, air intake body, throttle body, and bowl body cover for cracks and fractures. These are iron castings and may break. Blow out all air and jet holes with compressed air. Make certain air and jet holes are unobstructed.

(3) Inspect condition of solder which holds the halves of each float together. Look for cracks or breaks. Shake floats. If a slushing sound is heard, indicating gasoline within the float, the float leaks and must be discarded.

(4) Examine jets, venturi tubes, valve seats, and tubes for cracks, fractures, or possible obstruction due to dirt or other foreign matter.

(5) Examine threads of all screws, plugs, nuts, and connections. Be sure drilled openings are free of dirt and foreign matter. Examine valves, washers, levers, float axle hinge, and hinge bracket for breakage.

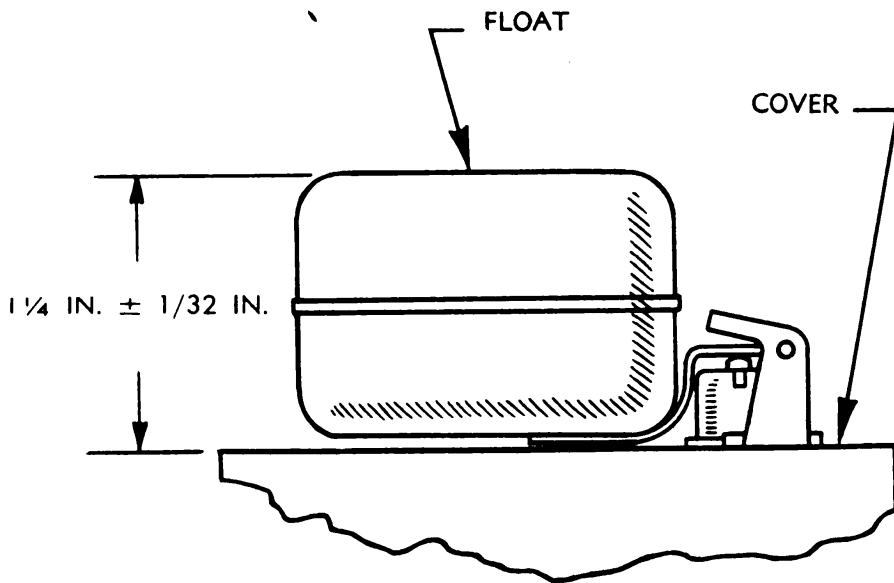
(6) Check all jet orifices with proper size drills. Standard drill sizes to check orifices are as follows: discharge jet orifice, drill size No. 26 (40-D-1890-26; main jet orifice, drill size No. 65 (40-D-1319); idling jet orifice, drill size No. 69 (40-D-1890-69); accelerating jet orifice, drill size No. 70 (40-D-1890-70). If worn oversize, replace with new jets. When replacing jets, make sure new jets have the same calibration numbers as the old.

c. Repair.

(1) MAINTENANCE.

(a) Remove, disassemble, and thoroughly clean in dry-cleaning solvent at least once a year or after every 500 hours of operation.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 73546

Figure 33—Float Level Dimension

(b) All carburetor adjustments, except idling, are fixed. For this reason the carburetor should give a minimum of trouble, providing regular cleaning and inspection schedules are maintained. However, carburetor jets will wear and result in an over rich mixture, reducing engine efficiency; therefore, it should be disassembled, cleaned, and inspected after 500 hours of operation.

(c) Correct fuel level is particularly important in obtaining greatest fuel economy. To obtain correct fuel level with normal pump pressure, the distance from the bottom of the float to the bottom of the cover should be $1 \frac{1}{4}$ inches, plus or minus $\frac{1}{32}$ inch (fig. 33).

(d) Uniform idling and part-throttle operation are particularly dependent upon the location of the priming plug in relation to the throttle plate. For this reason, throttle plates and bodies cannot be exchanged. When replacing throttle shaft or plate, back off throttle stop screw so that throttle plate can be closed. Hold the throttle in closed position and scribe a line on the inside of the throttle body along the throttle plate. Using the scribed line as a guide, replace throttle shaft on plate. If new plate shows a noticeable variation from old one, select another plate that fits closely to the scribed line.

(2) REPAIR.

(a) Few carburetor components can be repaired. Trouble of any kind except as noted below is cause for replacement of the complete carburetor or the individual part.

(b) If carburetor float leaks, replace or repair it. To repair, dry outer surface and shake float until gasoline is seen leaking from it

ENGINE AND ACCESSORIES

as shown by a damp spot on float. Mark location of leak, and puncture top of float with a sharp pointed tool. Drain gasoline from float through punctured hole. Solder leak and drain hole with a soldering copper. Do not use excessive solder as its weight would keep float from working properly.

(c) To insure correct fuel level with normal pump pressure, set the floats so that distance from the bottom of the floats to bottom surface of the cover is $1\frac{1}{4}$ inches, plus or minus $\frac{1}{32}$ inch, by bending the float arm (fig. 33).

d. Assembly (fig. 34).

(1) Push throttle shaft into throttle body. Insert throttle plate through shaft slot. When throttle plate is properly centered, install new screws to hold it in place. Peen over ends of screws, being careful not to spring shaft. Slide throttle lever onto shaft with pinholes in lever hub and shim aligned. Be sure lever points up. Drive pin into pinhole. Slide spring onto stop screw and install the screw into its boss on lever hub. Screw throttle control attaching screw into boss on end of lever.

(2) Position air shutter bracket on air intake body and install the special screw which attaches it to body. Slide air shutter shaft, lever attached (with washer and nut), in place. Insert shutter through shaft slot with relief valve spring up. Install new holding screws. Peen over ends of screws, being careful not to spring shaft. Install spring between bracket and lever.

(3) Using a gasket, screw hexagonal-head shaft hole plug screw in place over end of shaft opposite lever.

(4) Place venturi in throttle body. Install gasket, carefully setting it in proper position so that locating pin extends through gasket and the plate holes are not closed off. Place air intake body in position on throttle body, checking passages and locating pin. Turn upside down and install assembly washers and screws. Tighten screws evenly and securely.

(5) Screw well vent into position in bowl.

(6) Install main jet, with washer, through bowl plug hole. Install bowl plug and new washer.

(7) Install power jet valve and new washer. Have screwdriver properly centered on valve head.

(8) Install accelerating jet in the metering well, using a small screwdriver, while holding the meter well in the hand only.

(9) Install metering well and accelerating jet in the well channel in bowl. Metering well is designed to extend not more than 0.005 inch above the bowl casting to insure a good fit at that point when gasket and cover are in place. Screw vent well down in place.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

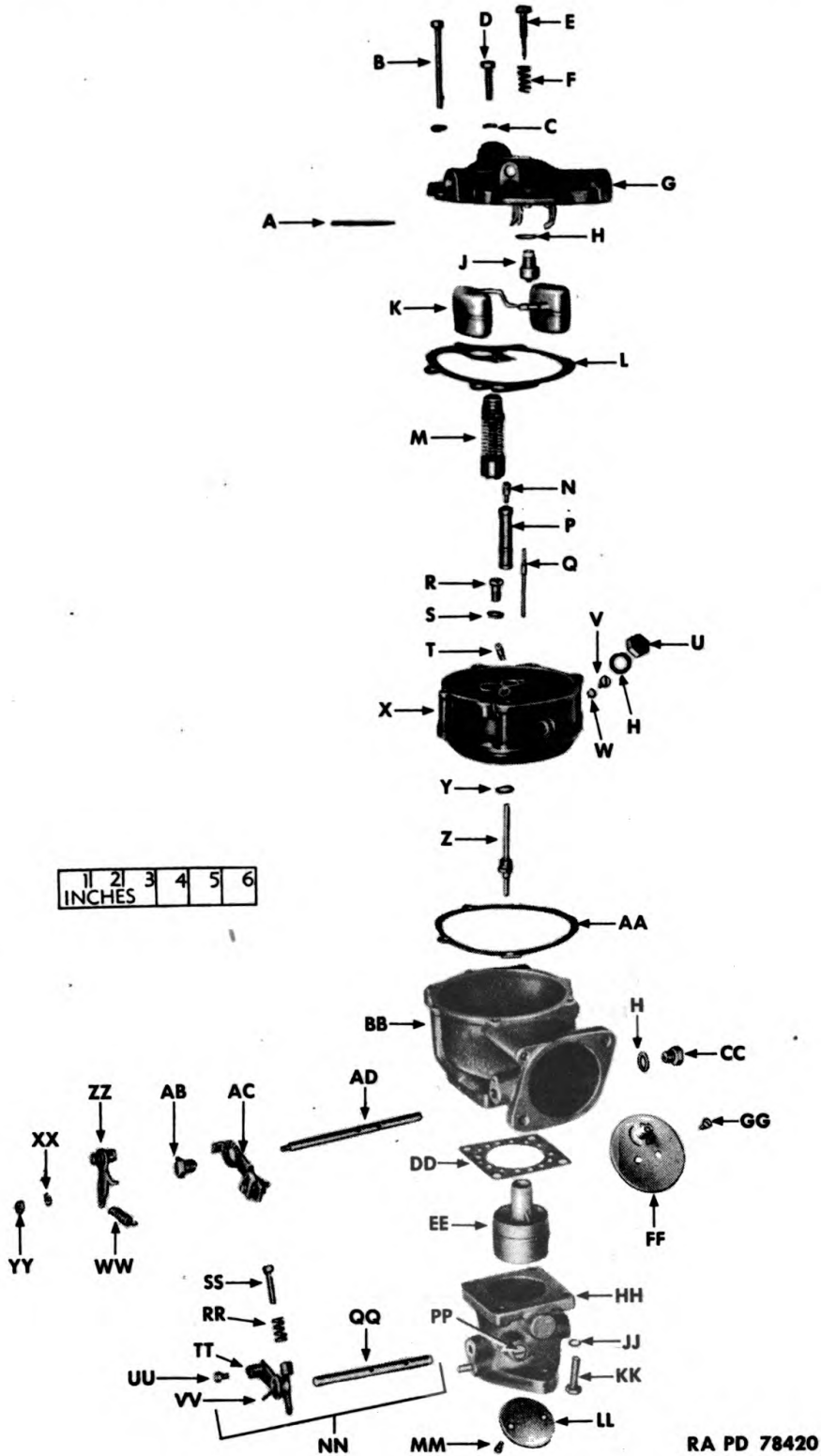


Figure 34—Carburetor Disassembled

ENGINE AND ACCESSORIES

A—AXLE—Z-C120-31
B—SCREW—BCFX2CR-1
C—WASHER—BECX1F
D—SCREW—BCFX2CH-1
E—SCREW—Z-C46-47
F—SPRING—Z-C111-17
G—COVER, ASSEMBLY—Z-B6-13
H—WASHER—Z-T56-23
J—VALVE—Z-C81-1-45
K—FLOAT—Z-C85-79
L—GASKET—A277250
M—PUMP—Z-C36-29X3
N—JET—Z-C55-19-14
P—WELL—Z-C76-27-2
Q—JET—Z-C54-22-15
R—VALVE—Z-C97-22-(17-15)
S—WASHER—Z-T56-14
T—JET—Z-C77-23-18
U—PLUG—Z-C138-23
V—JET—Z-C52-7-25
W—WASHER—Z-T56-24
X—BOWL, ASSEMBLY—Z-B3-89
Y—WASHER—Z-T56-20
Z—JET—Z-C66-57-80
AA—GASKET—A277240
BB—BODY—Z-B4-27
CC—SCREW—Z-C138-24
DD—GASKET—Z-C142-48
EE—VENTURI—Z-C38-57-29
FF—PLATE—Z-C101-41
GG—SCREW—Z-C136-3
HH—BODY, ASSEMBLY—Z-B2-149-2
JJ—WASHER—BECX3G
KK—SCREW—Z-T18S25-14
LL—PLATE—Z-C21-141
MM—SCREW—Z-C136-15
NN—SHAFT, ASSEMBLY—Z-C29-401
PP—PLUG—Z-CT91-3
QQ—SHAFT—Z-C23-360
RR—SPRING—Z-C111-62
SS—SCREW—Z-T8S10-15
TT—LEVER—Z-CR27-153
UU—SCREW—Z-T8S8-7
VV—PIN—BFCX1BA
WW—SPRING—Z-C112-6
XX—WASHER—BEAX1E
YY—NUT—BBMX1B-1
ZZ—LEVER, ASSEMBLY—Z-C106-2
AB—SCREW—Z-C140-7
AC—BRACKET, ASSEMBLY—Z-C109-2
AD—SHAFT—Z-C105-166

RA PD 78420A

Legend for Figure 34—Carburetor Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18

- (10) Set idling jet in place in bowl.
- (11) Screw fuel valve seat and washer into place in bowl cover. Insert needle into seat.
- (12) Place the float arm in position in float hinge bracket and secure with wire pin float axle. The float should move freely on the axle. Hold the float level upside down to observe relation of float to cover. If necessary, bend float arm to secure correct dimension (sub-par. c (2) (c), above).
- (13) Position pump in bowl cover. If disassembled, assemble pump as follows: place piston rod and piston head in chamber and secure in place with retainer plate; slide sleeve and small spring over piston; insert large spring in the retainer plate flange; attach brass pump head.
- (14) Place bowl-to-cover gasket in position on bowl. Hold cover assembly over bowl and guide vacuum piston into vacuum cylinder, and idling jet into its channel. Use care to avoid damage to float and other parts.
- (15) Install cover to bowl assembly screws and lock washers, tightening them evenly and securely.
- (16) Screw discharge jet (with washer) into place in lower side of bowl.
- (17) Place bowl to air intake body gasket in position on bowl. Place bowl assembly with gasket on the air intake body. Be sure channel bushings enter their respective channels. Install the assembly lock washers and screws, tightening them evenly and securely.
- (18) Place spring over idling adjusting screw and install screw in tapered hole in cover.

34. THROTTLE BODY.**a. Disassembly (fig. 35).**

- (1) Punch-prick throttle lever and throttle plate shaft at adjacent points, to facilitate correct assembly.
- (2) Remove the two screws and washers which secure throttle plate to shaft. Pull plate from shaft.
- (3) Pull shaft with attached lever, three flat washers, and two leather washers from body. Do not lose needle bearings which will fall from body as shaft is removed. Slide washers from shaft.
- (4) Pry bearing cup from body and tap out disk washer (plug). Lift brass washer from bushing.
- (5) Pull bushings from shaft bosses only if replacement is necessary. Do not pull bushings from attaching stud holes.

ENGINE AND ACCESSORIES

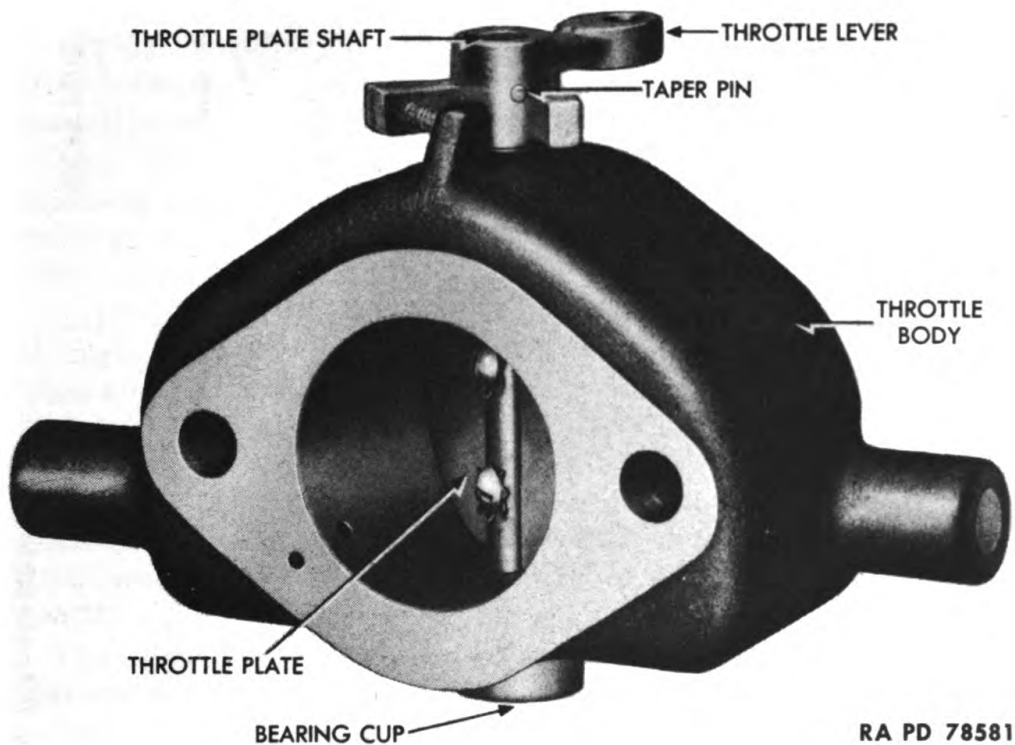


Figure 35—Throttle Body Assembled

(6) Drive out taper pin which attaches lever to shaft, and tap lever from shaft.

b. Inspection.

(1) Clean all metal parts in dry-cleaning solvent, and dry with a cloth.

(2) Inspect body to see if it is cracked. Rust marks are an indication of a fracture permitting leakage.

(3) Inspect shaft and bushings to see if they are scored.

(4) Inspect bearing rollers to see if any are chipped, broken, or noticeably worn.

(5) Inspect metal washers, lever, pin screws, and cap to see if any are bent or broken.

(6) Examine leather washers to see if they are crushed or torn.

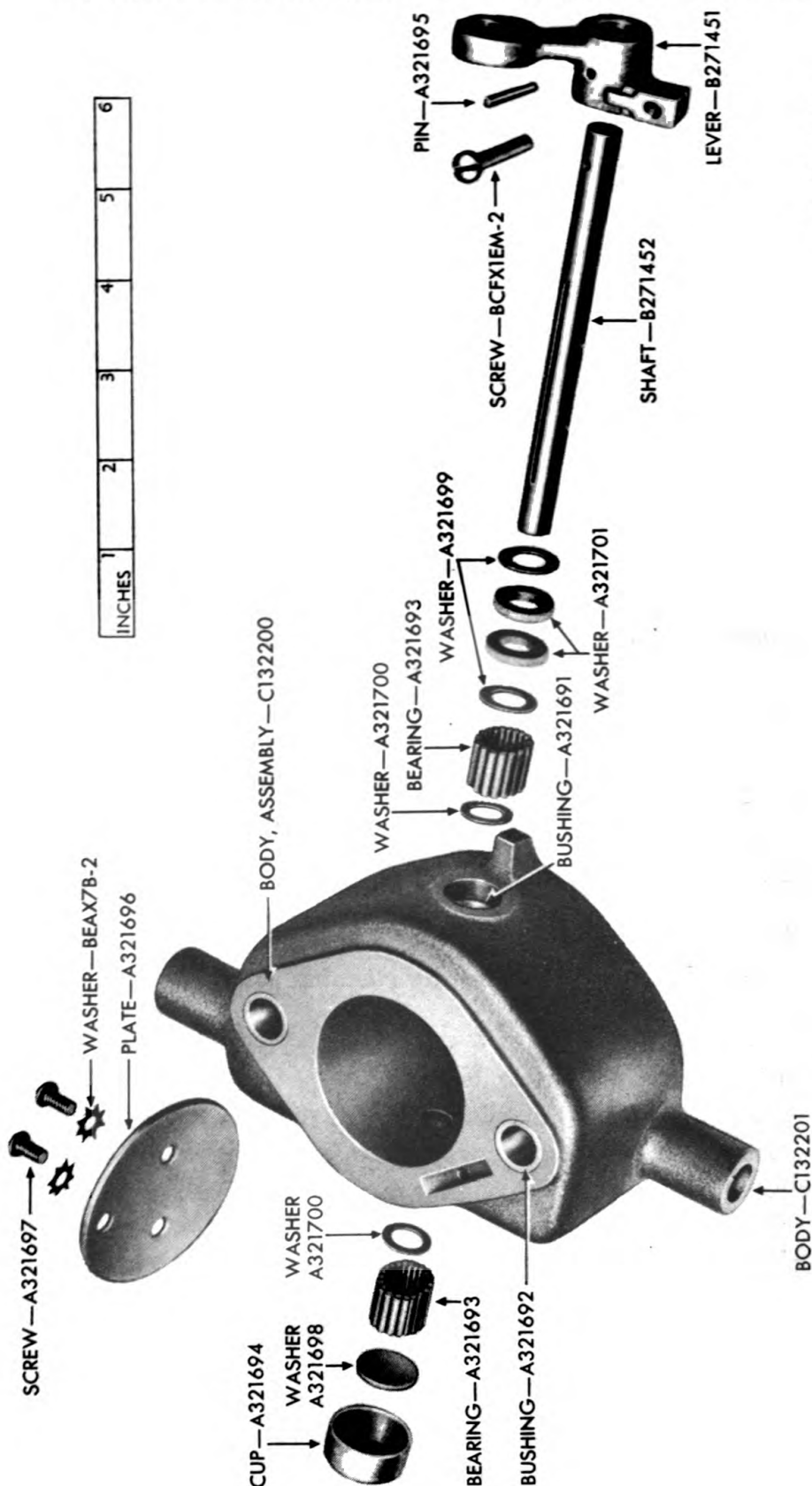
(7) Note condition of threads on screws and tapped holes.

c. Repair.

(1) Remove all burs with a fine mill file.

(2) Remove light score marks from shaft with crocus cloth.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78219

Figure 36—Throttle Body Disassembled

ENGINE AND ACCESSORIES

d. Assembly (fig. 36).

(1) If old shaft bushings were removed, press new bushings into shaft bosses on body. Ream bushing to secure 0.002-inch shaft clearance. If using a new shaft, ream bushing to 0.4945-inch inside diameter.

(2) Insert small diameter brass washer into body through each shaft bushing in body. Stick the 14 needles (which make up shaft bearing) in position within each bushing. Use general purpose grease (No. 0) to hold needles in position.

(3) Slide lever onto shaft so that punch-prick marks are alined. If marks were not made at time of disassembly, carefully measure taper pinholes in lever hub and in shaft. Aline larger lever hub pinhole with larger end of shaft pinhole. Tap taper pin to seat through lever hub and shaft.

(4) On shaft, slide large brass washer, two leather washers, and remaining large brass washer. Insert shaft through bearings in body from side having small shaft boss. Use care to keep from dislodging bearing rollers.

(5) Insert plate through slot in center of shaft. Install the two washers and screws which attach plate to shaft.

(6) Tap disk washer (plug) to seat over end of shaft in large shaft boss. Tap cup to seat over boss.

35. GOVERNOR.

a. Disassembly.

NOTE: *Key letters indicated in the disassembly and assembly procedure pertain to figure 40.*

(1) Pry snap ring from end of shaft. Press helical gear from shaft. Tap Woodruff key from shaft.

(2) Remove the two special screws which attach spring guide to body (fig. 37). Unhook extension spring from special eyebolt and lift guide and spring from body.

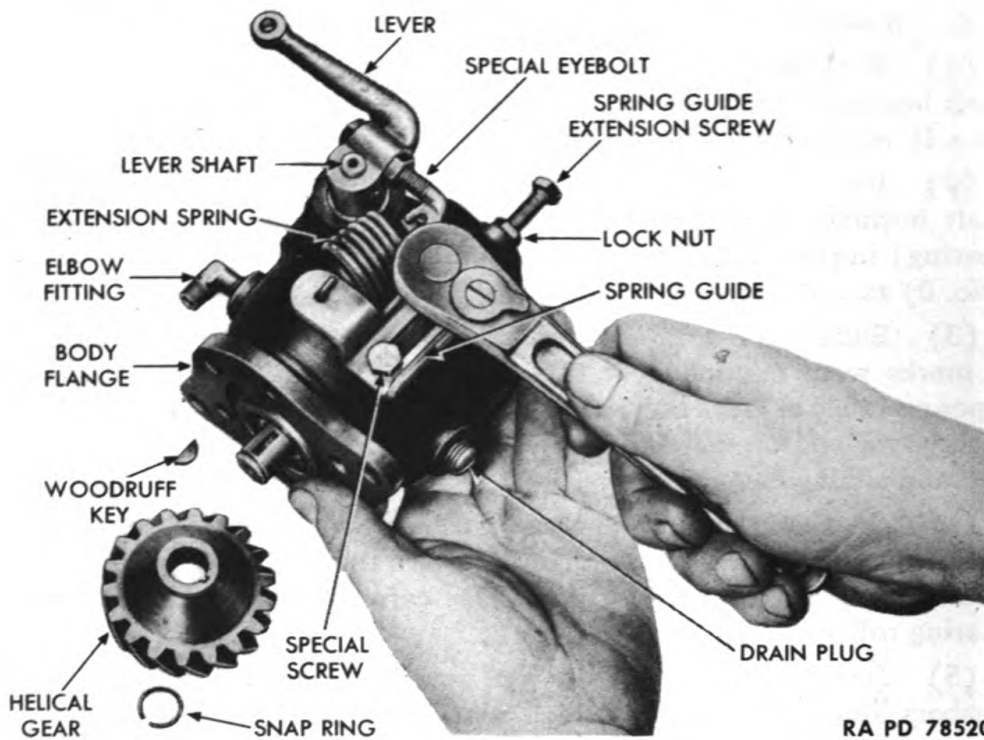
(3) Loosen lock nut and remove spring guide adjusting screw and lock nut.

(4) Remove oil level plug from front of body, elbow fitting (fig. 37) from top of body, drain plug from bottom of body, and screw with copper gasket from front of body.

(5) Drive taper pin from lever hub and lever shaft. Pull lever from shaft. Remove the nut from special eyebolt and lift eyebolt from lever.

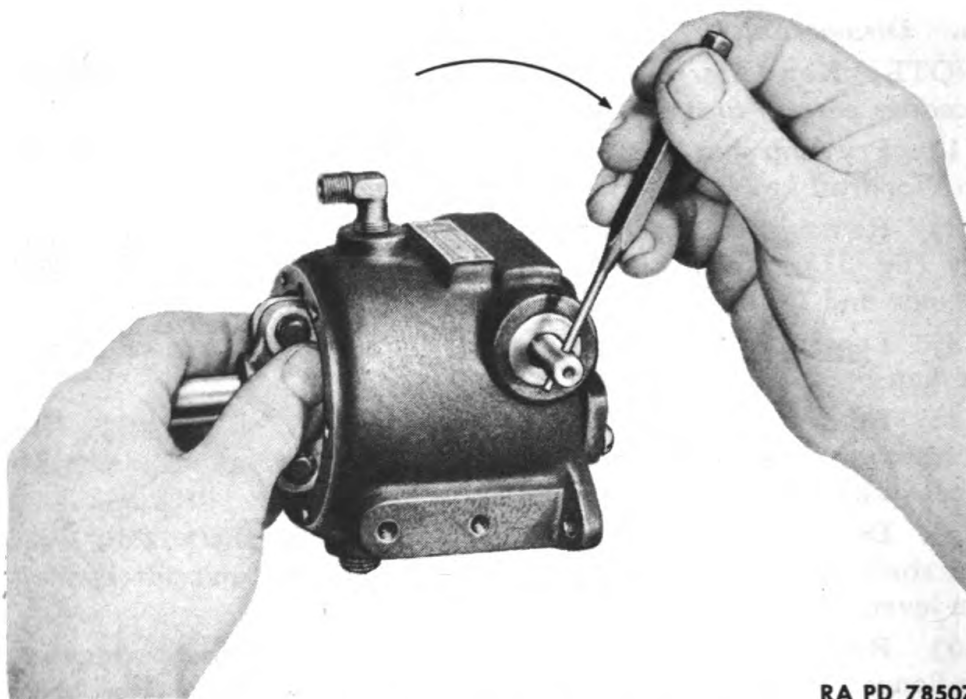
(6) Remove the six machine screws and lock washers which attach flange (fig. 37) to body. Tap flange to break it loose from body and remove with bearing and gasket. Tap bearing from flange.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78520

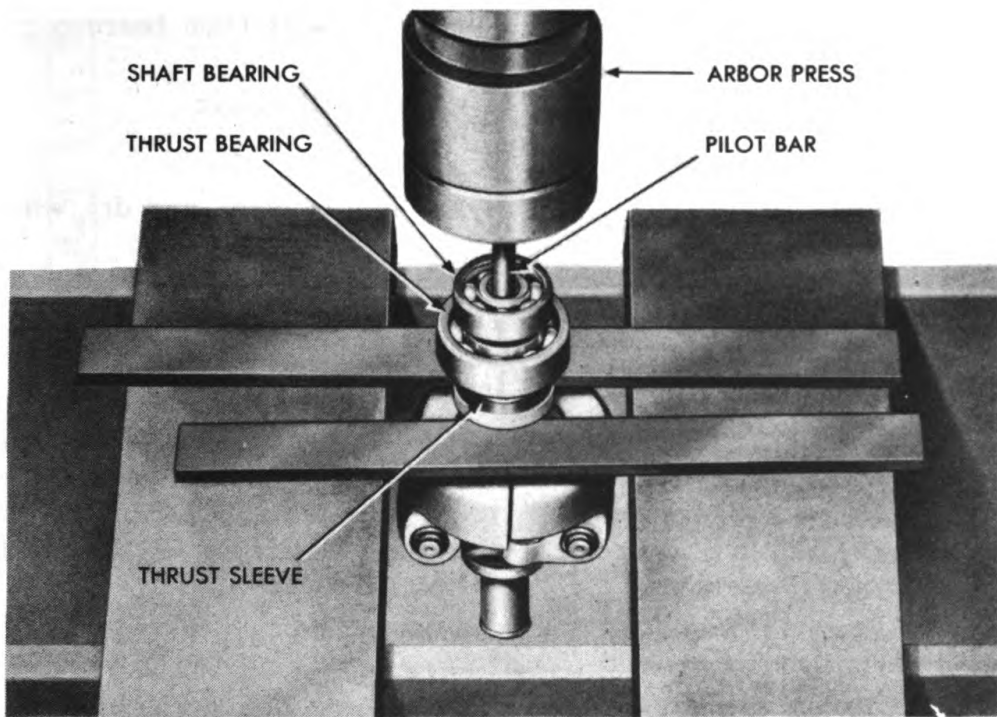
Figure 37—Governor Disassembly (1)



RA PD 78507

Figure 38—Governor Disassembly (2)

ENGINE AND ACCESSORIES



RA PD 78519

Figure 39—Pressing Bearing From Governor Shaft

(7) Insert a punch through pinhole in lever shaft and twist shaft clockwise (using punch as lever) to free weight shaft assembly (fig. 38). Lift shaft assembly from governor.

(8) Pull hairpin-type clip (V) from fork shaft and pull fork (U) and spring washer (X) from lever shaft (Z).

(9) Tap on protruding end of lever shaft (Z) to remove retainer (BB) from body on other end of shaft. Slide shaft, with one bearing, from body. Tap oil seal (PP) and remaining bearing (NN) from body (fig. 40).

(10) Pry snap ring (AA) from lever shaft (Z) and slide washer (CC) and bearing (DD) from shaft.

(11) Press shaft bearing (T) from front end of shaft, using an arbor press (fig. 39). Place blocks under thrust sleeve flange and place pilot bar to end of shaft. Slide thrust bearing (S) and thrust sleeve (R) from shaft after shaft bearing is removed.

(12) Remove hairpin-type clips (N) from each end of both weight pins (M). Press pins from weights (K) and shaft trunnions. Do not lose the two thin steel washers (J) which are freed upon removal of each pin from weight.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(13) Press weight bearings (P) from weights (two bearings in each of the two weights).

(14) Tap thrust surface stud (L) from each weight.

b. Inspection.

(1) Clean all metal parts in dry-cleaning solvent, and dry with compressed air. Do not allow air to spin bearings.

(2) Examine all bearings carefully to see if races and balls or rollers are chipped, burred, nicked, scored, or badly worn. Rotate bearings (do not spin) and listen for grinding noise which indicates defect.

(3) Inspect shaft, thrust sleeve, thrust surface studs on weights, fork, weight axles, and lever shaft to see if any are scored or burred.

(4) Examine flange and body castings to see if either is broken or cracked. Look for burrs on machined surfaces. Examine threads in tapped holes to see if any are burred or stripped.

(5) Inspect spring, snap rings, and hairpin-type clips to see if any are broken, bent, or sprung.

(6) Inspect spring guide, plugs, elbows, cup, nuts, weights, washers, and screws to see if any are broken or bent. Observe condition of threads on threaded parts.

(7) Examine oil seal to see if metal is bent or if leather is worn or torn.

c. Repair.

(1) Remove burrs from machined parts with a fine mill file. Dress slightly scored surfaces with crocus cloth. Replace governor assembly if unrepairable.

(2) Clean up burred or slightly damaged threaded parts with a tap or a die. Replace parts having stripped threads.

(3) Replace oil seal unless it appears to be in new condition. Replace all gaskets.

d. Adjustment.

(1) After governor has been assembled, install it on the generating unit engine.

(2) Loosen lock nut on adjusting screw and two special screws which attach spring guide.

(3) Turn adjusting nut until engine turns at 1,200 revolutions per minute (indicated by 60-cycle reading on frequency meter of Generating Unit M18). Increasing spring tension increases engine speed.

(4) Tighten lock nut on adjusting screw. Tighten special screws which attach spring guide to body.

1	2	3	4	5	6
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INCHES

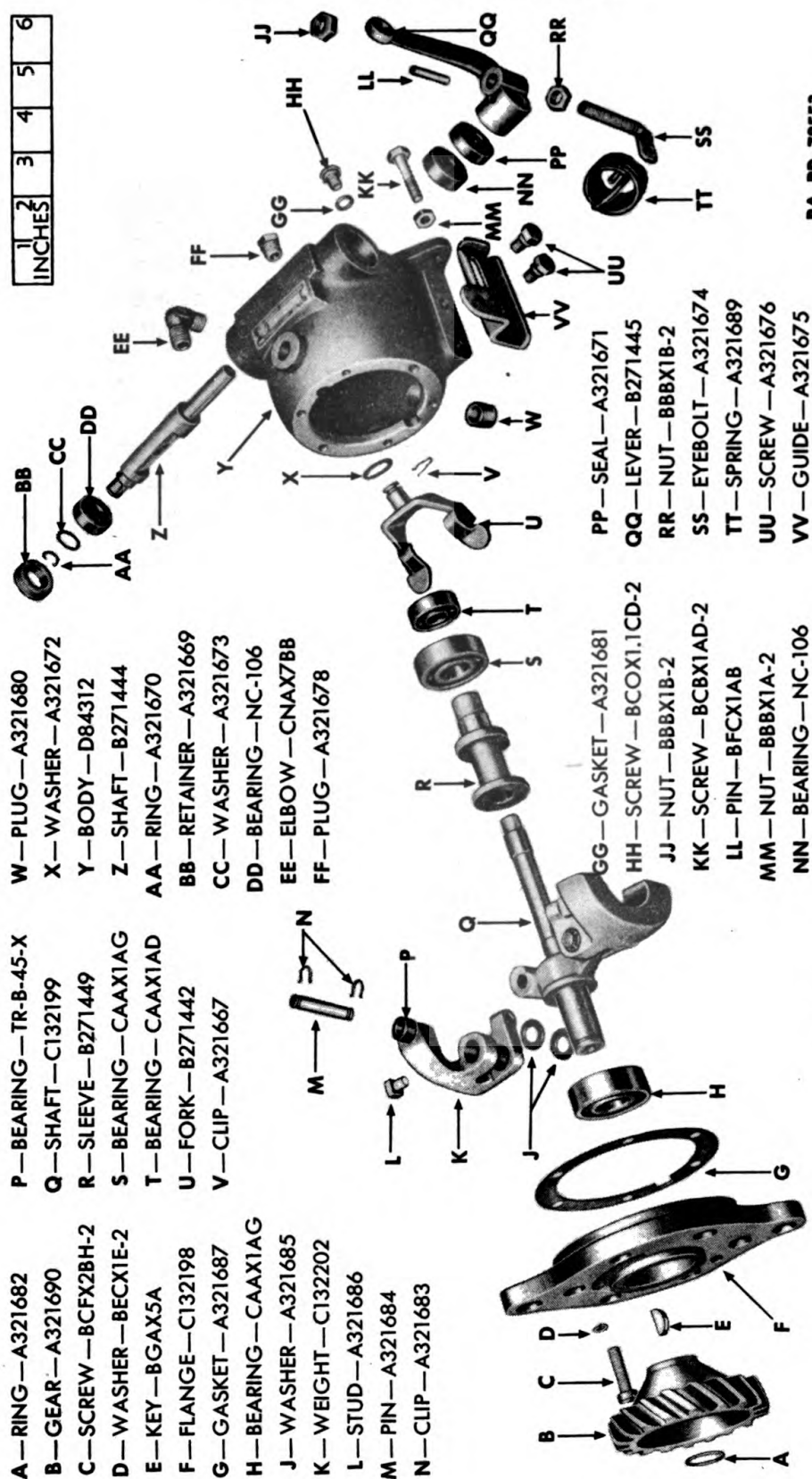


Figure 40—Governor Disassembled

RA PD 78553

ORDNANCE MAINTENANCE—GENERATING UNIT M18

e. Assembly (fig. 40).

(1) Tap thrust surface stud (L) into position in each weight. Press the two bearings (P) into each weight (K) so outer ends of bearings are flush.

(2) Position one weight assembly between trunnions on shaft (Q). Insert steel washer (J) on each side of weight. Press weight pin (M) through openings in shaft trunnions, both washers, and weight bearings. Snap hairpin-type clip (N) onto each end of installed weight pin. Repeat procedure to assemble other weight to shaft.

(3) Slide thrust sleeve (R), collar first, onto shaft. Slide thrust bearing (S) onto sleeve. Press shaft bearing (T) onto end of shaft.

(4) Slide bearing (DD) and washer (CC) onto end of lever shaft (Z) which is grooved to receive snap ring (AA). Install snap ring in groove. Slide shaft into position in body from left (plain) side of body. Tap other shaft bearing (NN) and oil seal (PP) into position in body at other (right) end of shaft. Tap retainer into position in body over left end of shaft.

(5) Slide spring washer (X) onto fork shaft and insert fork shaft through lever shaft (Z) inside body. Be sure fork is on flattened side of lever shaft. Install hairpin-type clip (V) in groove on end of fork shaft.

(6) Insert a punch through pinhole in lever shaft. Use punch as a lever and turn shaft so fork points toward open end of body. Insert weight and shaft assembly into body. Twist lever shaft counter-clockwise to position fork between collars on thrust sleeve as weight and shaft assembly is inserted. Tap bearing on end of shaft to seat in body. Remove punch from pinhole in lever shaft.

(7) Tap remaining shaft bearing to seat in flange. Position new gasket (G) on flange with notch in gasket alined with oil drain hole in flange. Slide flange assembly over protruding end of shaft. Twist flange so drain hole is alined with notch at bottom of body. Install the six lock washers and screws which attach flange to body.

(8) Screw nut (RR) onto eyebolt (SS) and insert eyebolt through bolt hole in lever (QQ) so that eye in eyebolt points in the opposite direction from lever. Install other nut on eyebolt. Position lever on shaft (Z) with lever pointing up. Tap taper pin (LL) to seat through lever hub and shaft.

(9) Piston spring guide (VV) (spring hole up) on body and install the two special screws fingertight. Clip spring into holes in guide and in eyebolt. Screw lock nut onto spring guide adjusting screw (KK) and install the screw through flange on front of governor. Tighten screw sufficiently to hold spring in position.

ENGINE AND ACCESSORIES

(10) Tap key (E) into keyway on shaft and press helical gear onto shaft. Install snap ring (A) into groove on end of shaft.

(11) Install copper gasket (GG) and screw (HH) in screw hole on lower front of body. Install drain plug in plug hole on under side of body. Screw oil elbow into elbow hole on top of body. Tighten elbow so it points toward front of governor. Install oil level plug in plug hole on front of body.

(12) Adjust governor to 1,200 revolutions per minute (subpar. d, above).

36. FUEL PUMP.**a. Disassembly (fig. 41).**

(1) Loosen nut (V) on bail and screw at bottom of sediment bowl (Q). Swing bail out and remove bowl and gasket. Spread bail and remove bail and screw, nut, and bowl seat. Lift screen (K) from body.

(2) Remove screws which attach bottom cover (JJ) to body (V). Remove bottom cover, gasket, two springs, and spring cap.

(3) Remove air dome (A) and plug (B) from top cover. Lift the two gaskets, valve springs, and valves from top cover.

(4) Scribe-mark top cover and body to facilitate proper assembly. Remove screws and washers which attach top cover to body, and lift top cover from body.

(5) Remove snap ring (Z) from each end of linkage and arm attaching pin (AA), and tap pin from body. Remove arm (GG) from body.

(6) Remove hairpin-type clips (EE) from each end of the two link pins (DD). Remove pins, links, and diaphragm and rod assembly from body.

(7) From end of rod, remove nut (J), small washer (L), large washer (N), protector (P), diaphragm (R), protector (S), and washer (U), respectively.

b. Inspection.

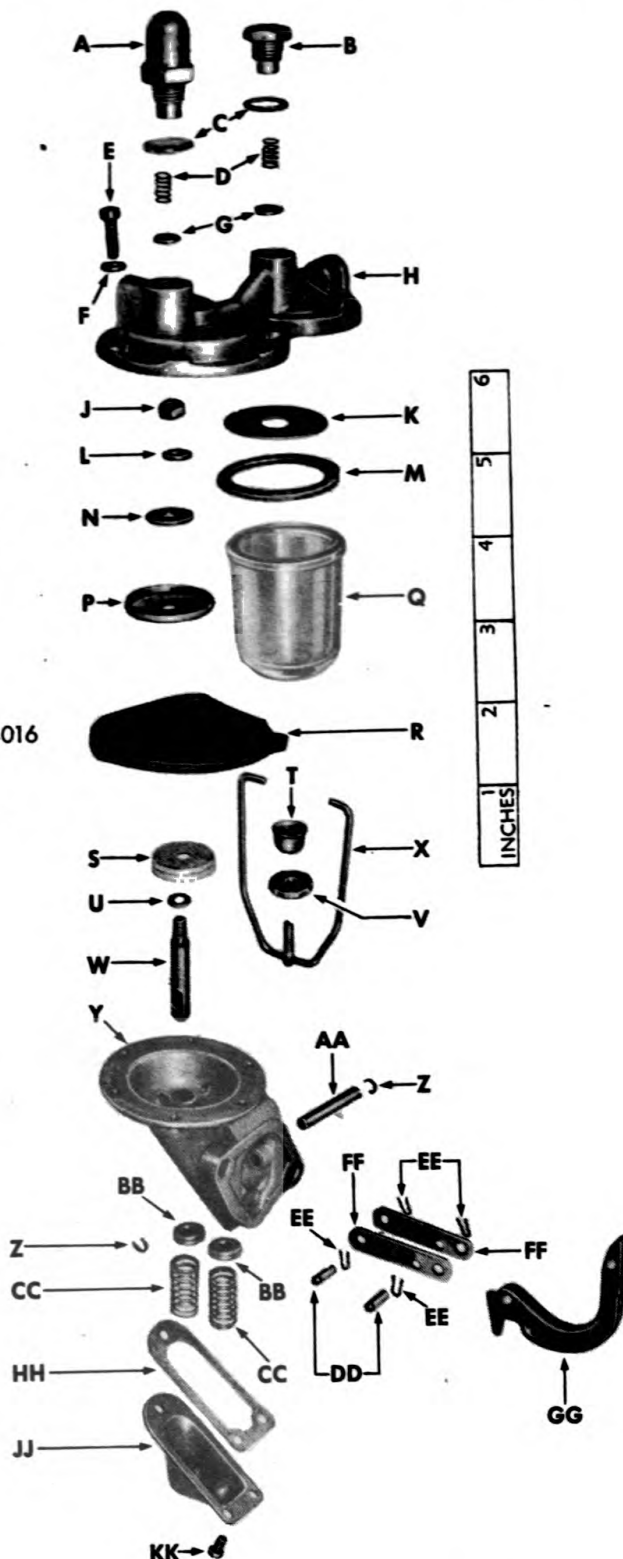
(1) Clean all parts in dry-cleaning solvent, and dry with compressed air.

(2) Examine body, top cover, and bottom cover to see if metal is cracked or broken. Note condition of valve seats. Seats should be flat and free of pits and marks.

(3) Inspect valves and valve springs. Valves must be free of gummy residue and perfectly flat. Springs must be clean and neither stretched nor compressed. Do not stretch springs as that changes their tension and affects pump action adversely.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

- A—DOME—AC-855789
 B—PLUG—AC-855135
 C—GASKET—AC-855136
 D—SPRING—AC-856270
 E—SCREW—BCGX1.1BG-5
 F—WASHER—BECX3E
 G—VALVE—AC-855003
 H—COVER—AC-1523358
 J—NUT—BBBX1A-1
 K—SCREEN—AC-854009
 L—WASHER—AC-855390
 M—GASKET—AC-854003
 N—WASHER—AC-855029
 P—PROTECTOR—AC-1521194
 Q—BOWL—AC-854004
 R—DIAPHRAGM—AC-855035
 S—PROTECTOR—AC-855078
 T—SEAT—AC-854005
 U—WASHER—AC-855012
 V—NUT—AC-855763
 W—ROD—AC-855250
 X—BAIL AND SCREW—AC-854016
 Y—BODY—AC-1523760
 Z—SNAP RING—AC-1521288
 AA—PIN—AC-1521289
 BB—CAP—AC-855532
 CC—SPRING—AC-855253
 DD—PIN—AC-855016
 EE—CLIP—AC-855017
 FF—LINK—AC-855374
 GG—ARM—AC-856242
 HH—GASKET—AC-855229
 JJ—COVER—AC-855228
 KK—SCREW—BCGX1.1BD-5



RA PD 46655

Figure 41—Fuel Pump Disassembled

ENGINE AND ACCESSORIES

(4) Inspect diaphragm to see if it is torn (especially around screw and rod holes), wrinkled, or stretched.

(5) Examine all gaskets to see if any of them are torn, crushed, or compressed.

(6) Examine screen for breaks, tears, and sand or other foreign substances impregnated in screen.

(7) Inspect the pins for wear and check for elongated holes in the links and arm. Check section of arm which rides on camshaft for wear.

(8) Inspect remaining parts to see if any are bent, broken, or burred. Note condition of threads on threaded part.

c. Repair.

(1) Replace diaphragm and all gaskets unless they appear to be in new condition. Replace fuel assembly pump if not repairable with authorized spare parts.

(2) Clean off all burs with a fine smooth file.

(3) Smooth pitted valve seats by sanding them with a small disk of flint paper (class B, No. 00) glued to the end of a $1\frac{7}{32}$ -inch round iron rod. Place the end of rod bearing paper against valve seat. Oscillate rod until seat is smooth.

(4) Scrape gummy residue from valves, using care to keep from cutting or breaking them. Sand valves smooth after scraping. Inspect valves closely after cleaning and replace if condition does not appear perfect.

d. Assembly (fig. 41).

(1) On rod (W), place small washer (U); protector (S), with flat surface facing up; diaphragm (R); protector (P); large washer (N); small washer (L); and nut (J), respectively. Be sure diaphragm lies flat between protectors and that lips of protectors are away from diaphragm. Twist rod so that screw holes in diaphragm will aline with screw holes in body when flat sides of rod are parallel to flat sides of bottom cover (JJ). Tighten nut securely.

(2) Insert rod and diaphragm assembly into position in body. Assemble the two links (FF) to rod with pin (DD) and two clips (EE). Also install pin through center holes of links, and install clips. Position arm (GG) in body over link pin installed last. Install long pin (AA) through body, both links, and arm. Install the two snap rings (Z) on end of pin.

(3) Match scribe marks, on top cover and body, made during disassembly, and carefully position top cover on body over diaphragm. Be sure screw holes in cover, diaphragm, and body are perfectly alined without twisting diaphragm. If necessary, loosen nut (J) on rod (W)

ORDNANCE MAINTENANCE—GENERATING UNIT M18

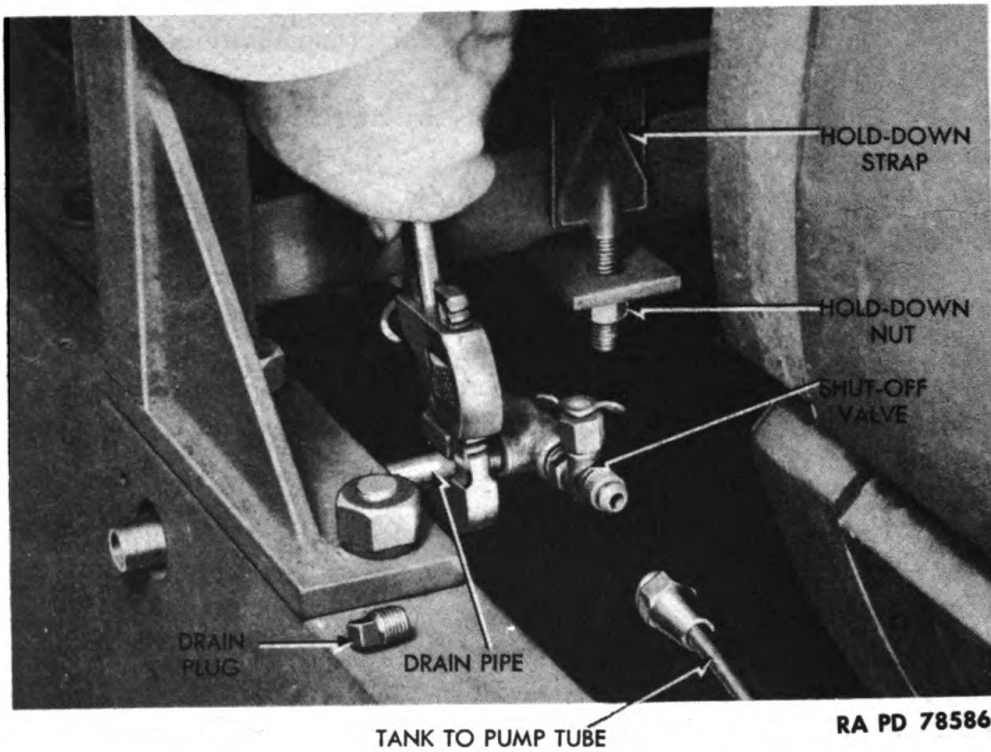


Figure 42—Gasoline Tank Removal (1)



Figure 43—Gasoline Tank Removal (2)

ENGINE AND ACCESSORIES

and turn diaphragm to secure alinement, and retighten nut. Install screws and washers which attach cover to body.

(4) Position gasket (HH) on bottom cover. Place the two springs (CC) in position inside cover. Place spring caps (BB) on springs. Carefully position cover (JJ) to body, making sure spring caps engage bottom of push rod (W) and lug on arm (GG). Install the three screws which attach cover to body.

(5) Place a valve (C) on each valve seat in top cover. Position a valve spring on each valve. Slide gasket onto air dome and valve plug. Screw air dome tightly into valve boss adjacent to pump outlet. Screw valve plug tightly into valve boss over sediment bowl.

(6) Place screen (K) in position on under side of top cover. Screw nut (V) onto screw on bail. Place bowl seat (T) on nut. Hook bail to top cover. Position bowl gasket (M) on bowl, and bowl to top cover. Swing bail under bowl and tighten nut.

37. GASOLINE TANK.**a. Removal (figs. 42 and 43).**

(1) Remove drain plug from end of drain pipe and drain all fuel from tank into clean container.

(2) Disconnect tank-to-pump tube from shut-off valve near tank. Screw drain pipe from tee. Screw nipple, tee, and shut-off valve (as an assembly) from elbow beneath tank.

(3) Remove gasoline tank guards and gasoline tank guard plate.

(4) Remove hold-down nut and washer from stud on each hold-down strap assembly. Bend straps back away from tank. Lift the two pieces of webbing from top of tank. Lift tank from gasoline tank support.

(5) To remove tank hold-down straps, remove the two screws which attach each strap to gasoline tank support.

b. Disassembly (fig. 44).

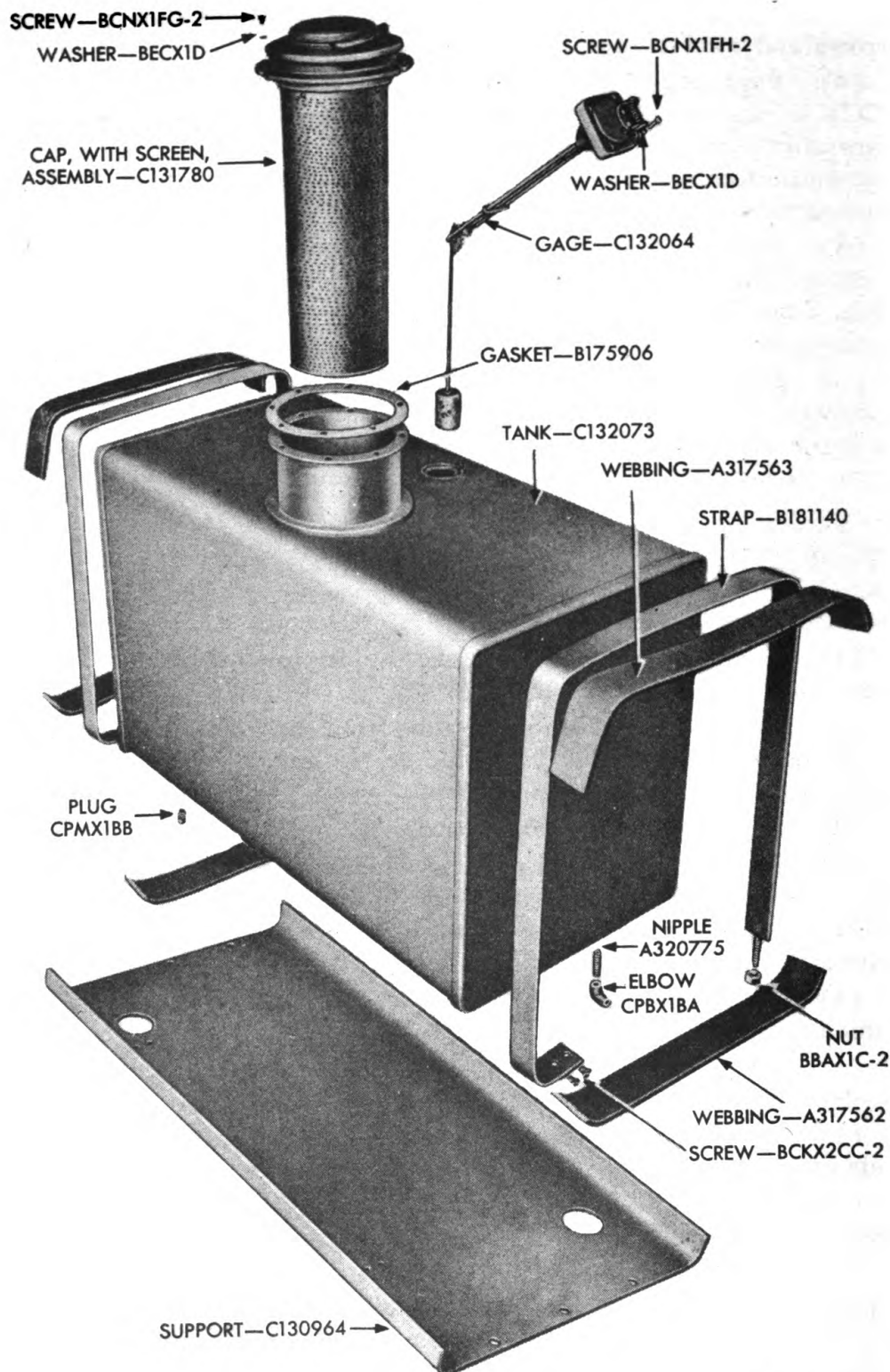
(1) Unscrew pipe plug, elbow, and nipple from bosses on under side of tank.

(2) Remove the four screws which attach gage to tank. Lift gage assembly and synthetic rubber washer from tank.

(3) Screw cap counterclockwise from filler neck. Screw screen assembly counterclockwise from filler neck. Remove the eight screws and lock washers which attach cap and screen assembly body to tank filler neck. Lift body and gasket from filler neck.

(4) To disassemble cap, remove cotter pin from end of valve on under side of cap. Slide chain, washer, and spring from valve. Remove

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78388

Figure 44—Gasoline Tank Disassembled

ENGINE AND ACCESSORIES

four screws from cap cover. Lift cover, valve, gasket, and handle from cap. Shake valve to remove washer (plug), spring, and valve (ball) from valve body.

c. Inspection.

- (1) Clean all parts in dry-cleaning solvent, and wipe dry with a clean cloth.
- (2) Inspect exterior of tank for discoloration which indicates leakage.
- (3) Tip tank from side to side and listen for noise which indicates presence of foreign objects in tank.
- (4) Reach through filler neck and test baffle for security of attachment.
- (5) Examine tank for dents which might affect strength of capacity of tank.
- (6) Lift gage float through its arc of operation and observe dial to see if it registers correctly.
- (7) Inspect all parts of cap and screen assembly to see if any are bent, broken, or badly worn.
- (8) Inspect straps to see if they are bent or broken. Note condition of threads on studs, nuts, and attaching screws.
- (9) Inspect webbing to see if it is torn, crushed, or deteriorated.

d. Repair.

- (1) Repair leaks in tank by soldering or welding. **CAUTION:** *Have tank completely filled with water, or carbon dioxide gas from dry ice, before bringing an open flame near it.*
- (2) Empty foreign objects from tank. In case of sand or a similar substance, clean tank with dry-cleaning solvent.
- (3) Reach through filler neck and solder baffle in place if it is loose. Use a soldering iron. *Do not use a torch.*
- (4) Bump out serious dents by reaching through filler neck. If dent is behind baffle, solder an L-shaped bar of solder to center of dent on outside of tank. Hit the bar with sharp blows to pull metal to proper position. Heat solder and remove bar from tank. If a torch or other open flame is used to heat solder, first fill tank with water or place dry ice in tank.
- (5) Replace tank if it is damaged beyond proper repair.
- (6) Replace all bent, broken, or badly worn parts of cap and screen assembly.
- (7) Straighten straps if bent. Weld or replace if broken. Replace threaded parts if stripped. Replace crushed, torn, or deteriorated webbing.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

e. Assembly (fig. 44).

(1) Assemble cap as follows: Insert valve (ball), spring, and washer (plug) into valve assembly. Position handle, gasket, valve, and cover on top of cap. Install the four screws which attach cover to cap. Slide spring and washer onto lower end of valve. Install chain and cotter pin on lower end of valve.

(2) Position gasket and cap and screen assembly body on filler neck of tank. Install the eight lock washers and screws which attach body to tank. Screw screen assembly into body. Screw cap into body.

(3) Position gage in tank so that float extends toward rear of tank. Install the four screws which attach gage to tank.

(4) Screw pipe plug into left rear boss on bottom of tank. Screw nipple and elbow into right front boss on bottom of tank. Tighten elbow so it points toward front of tank.

f. Installation (figs. 42 and 43).

(1) Position the two tank straps on gasoline tank support. Install the two screws which attach each strap to support.

(2) Place three pieces of webbing on gasoline tank support and set tank in position on webbing. Bend straps around tank and insert strap studs through their supports. Slide a length of webbing between top of tank and each strap. Install washer and nut on each strap stud.

(3) Install nipple, tee, and shut-off valve in elbow under tank. Tighten securely. Install drain pipe into tee and drain plug into pipe. Connect tank to pump fuel tube to shut-off valve.

(4) Fill tank with gasoline and inspect connections for leaks. Absence of leaks indicates satisfactory installation.

(5) Install gasoline tank guard plate and guards.

38. GASOLINE LINES AND VALVES.

a. Inspection.

(1) **TUBING.** Blow out with compressed air and inspect for cracks. Pay particular attention to ends of tubing beneath nuts. Look for sharp kinks which might obstruct tube. Examine nuts for cracks or stripped threads.

(2) **VALVES.** Visually inspect valves for cracks and stripped threads. Test operation by attempting to blow through valve when open and when closed.

b. Repair.

(1) **TUBING BROKEN UNDER NUT.**

(a) Shove nut back from end of tubing and saw off cracked end of tubing.

ENGINE AND ACCESSORIES

- (b) Flare end of tubing and pull nut back in place.
- (2) **TUBING KINKED.** Kinked tubing often breaks when straightened. Attempt to straighten kink. Inspect carefully for evidence of breaking. Blow through tubing to see if it is obstructed.
- (3) **TUBING SPLIT.** Replace split tubing. If no replacement is available, make temporary repair by soldering break. Be sure ends are open when soldering tubing.
- (4) **NUT INSTALLATION.** Examine end of tubing. If cut at an angle, saw off square. Slide nut on tubing, with threaded end of nut toward end of tubing. Flare end of tubing.
- (5) **VALVES.** Replace valves which do not operate correctly or which have stripped threads.

Section IV

EXHAUST SYSTEM

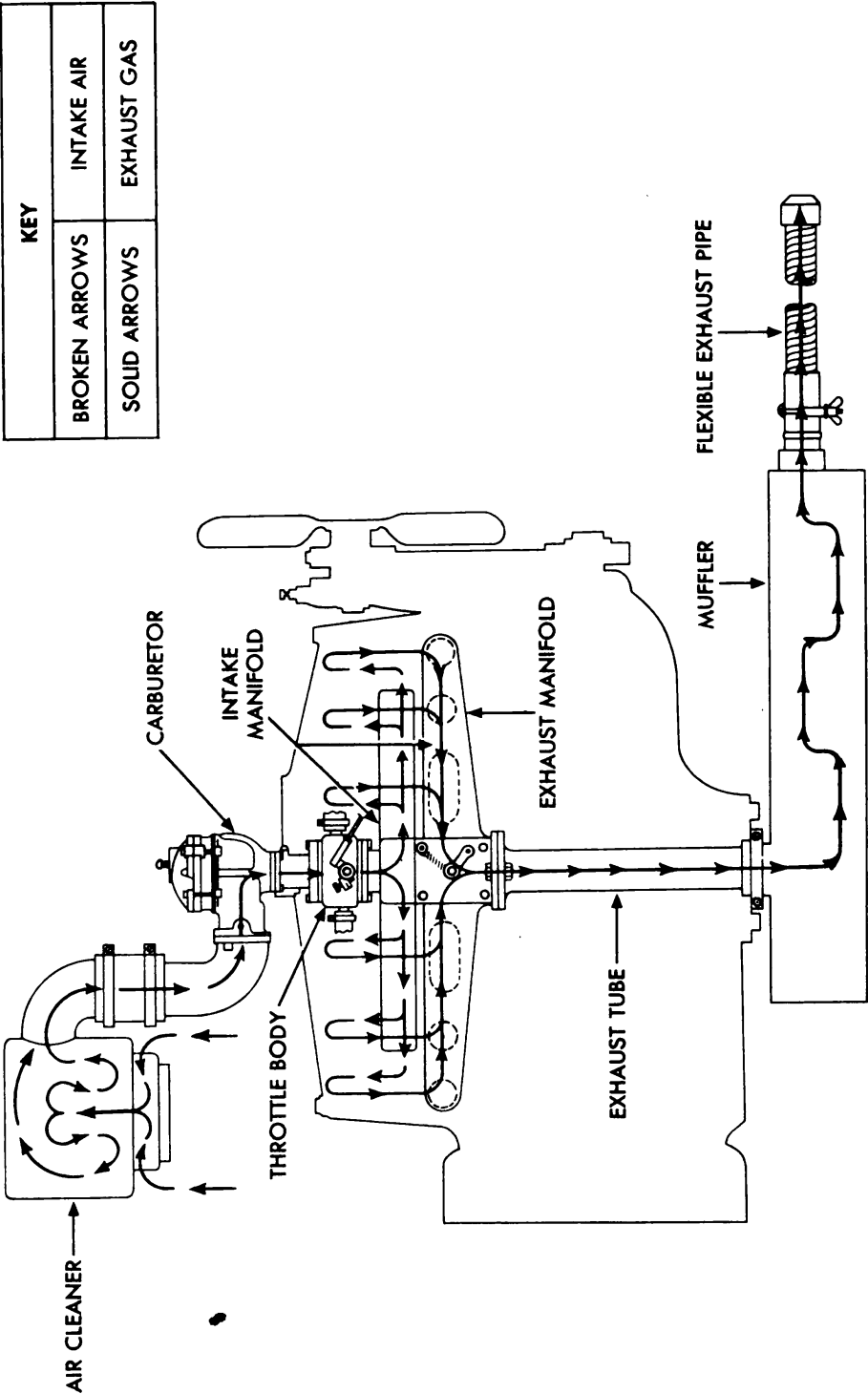
39. DESCRIPTION.

a. **General** (fig. 45). The exhaust system is composed of a manifold, an exhaust tube, a muffler, and a flexible exhaust pipe. Through this system the exhaust gases are conducted from the engine. The exhaust system discharges these gases to the atmosphere at the front of the unit.

b. **Manifold** (fig. 46). The exhaust manifold, together with the intake manifold, is of one-piece cast iron construction. It is attached to the right side of cylinder block by 10 bolts. The exhaust from the engine cylinders is collected by the exhaust manifold and passed through the exhaust tube to the muffler. A heat control valve is located in the exhaust manifold, and is designed to direct the exhaust gases through passages to heat the intake portion of the manifold during cold weather operation. The valve is manually adjusted by a lever, which is held in position by a spring. To adjust valve, slide lever to "HOT" position for cold weather operation and to "COLD" position for warm weather operation.

c. **Exhaust Tube** (fig. 48). The exhaust tube is constructed of heavy sheet steel. It is approximately 14 inches long and $2\frac{3}{8}$ inches in diameter. The tube fits onto a split sleeve on the muffler and is secured to it with a clamp. The outside of tube is covered with a sheet of asbestos. An expanded metal lath insulation cover holds the asbestos cover in place.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78503

Figure 45—Intake and Exhaust System Diagram

ENGINE AND ACCESSORIES

d. **Muffler** (fig. 49). Muffler is of welded sheet steel construction. It is cylindrical in shape, and is about 34½ inches in length. It is insulated in the same manner as the exhaust tube.

e. **Flexible Exhaust Pipe** (fig. 45). The flexible exhaust pipe consists of a length of flexible steel tubing with a sheet steel sleeve welded to each end. The sleeve on the attaching end is split and equipped with a clamp consisting of a circular clamp bolt with a wing nut. This clamp is spot-welded to the sleeve. Over-all length of the assembly is approximately 44 inches.

40. MANIFOLD.

a. Disassembly.

(1) Remove four nuts from studs which attach valve assembly to exhaust manifold and remove valve assembly and gasket (fig. 46).

(2) Unhook and remove spring from shaft and clip on valve assembly (fig. 47).

(3) Drive out two pins which secure shaft to valve and slide shaft from plate and valve (fig. 47).

(4) Drive out pin which attaches lever to shaft, and remove lever from shaft (fig. 47).

(5) Remove the four studs which attach the plate to manifold (fig. 46).

(6) Screw crankcase breather valve from intake manifold.

b. Inspection and Repair.

(1) At frequent intervals, examine manifold for cracks; repair by welding or by replacing manifold.

(2) Use new gaskets whenever the old ones are removed.

(3) Check studs which attach manifold to cylinder block for tightness. If threads are damaged or stripped, replace studs.

(4) Check spring for sufficient tension, and replace if weak.

(5) Check dowels for tightness.

c. Assembly (figs. 46 and 47).

(1) Screw crankcase breather valve into tapped hole at rear of intake manifold.

(2) Install the four studs which attach valve assembly to manifold.

(3) Position shaft onto lever and line up drilled holes. Drive in pin which secures lever to shaft. Peen the end of the pin.

(4) Slide shaft onto plate and valve, and line up pinholes. Drive in and peen the two pins which secure shaft to valve.

RA PD 78425

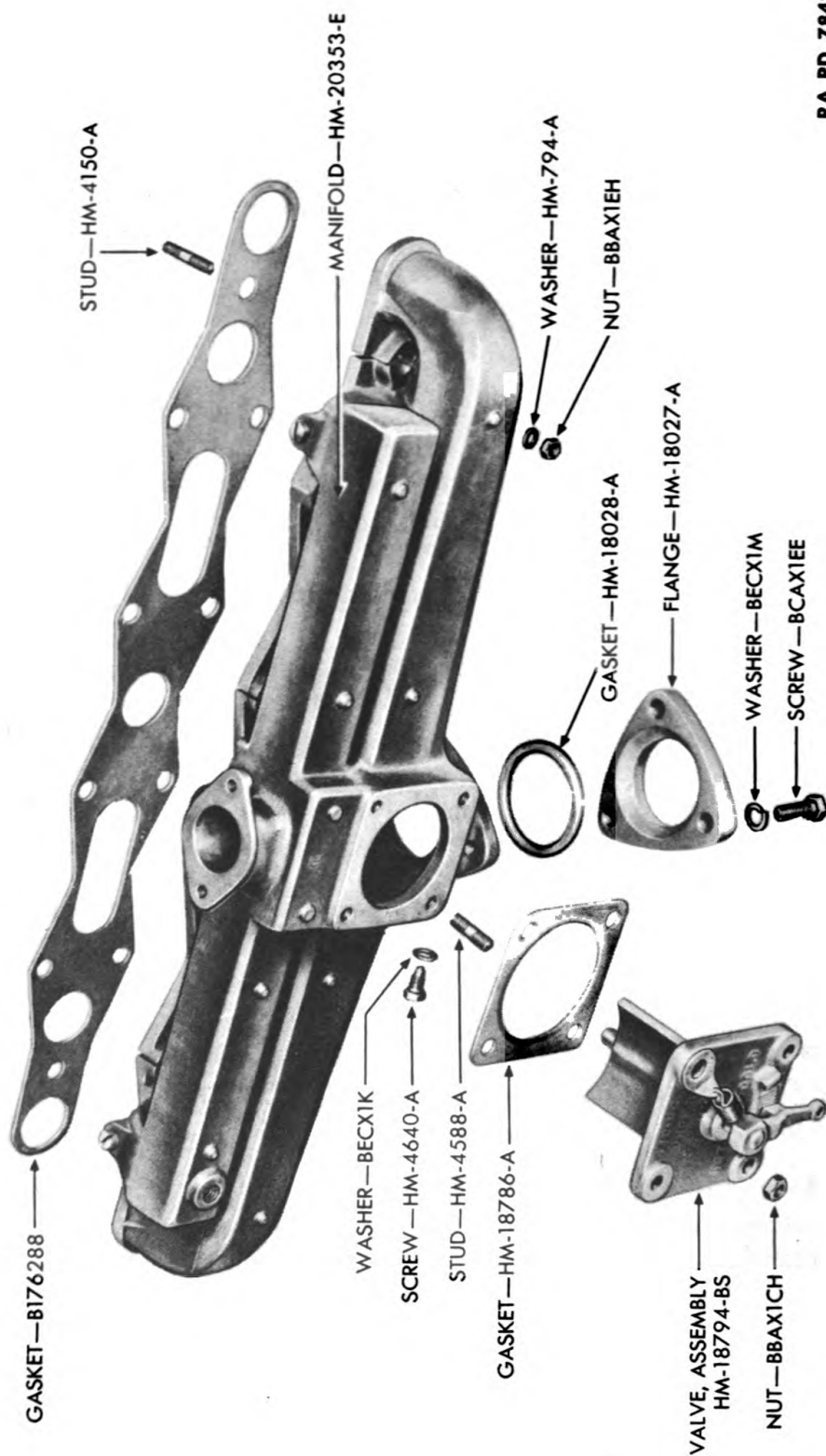
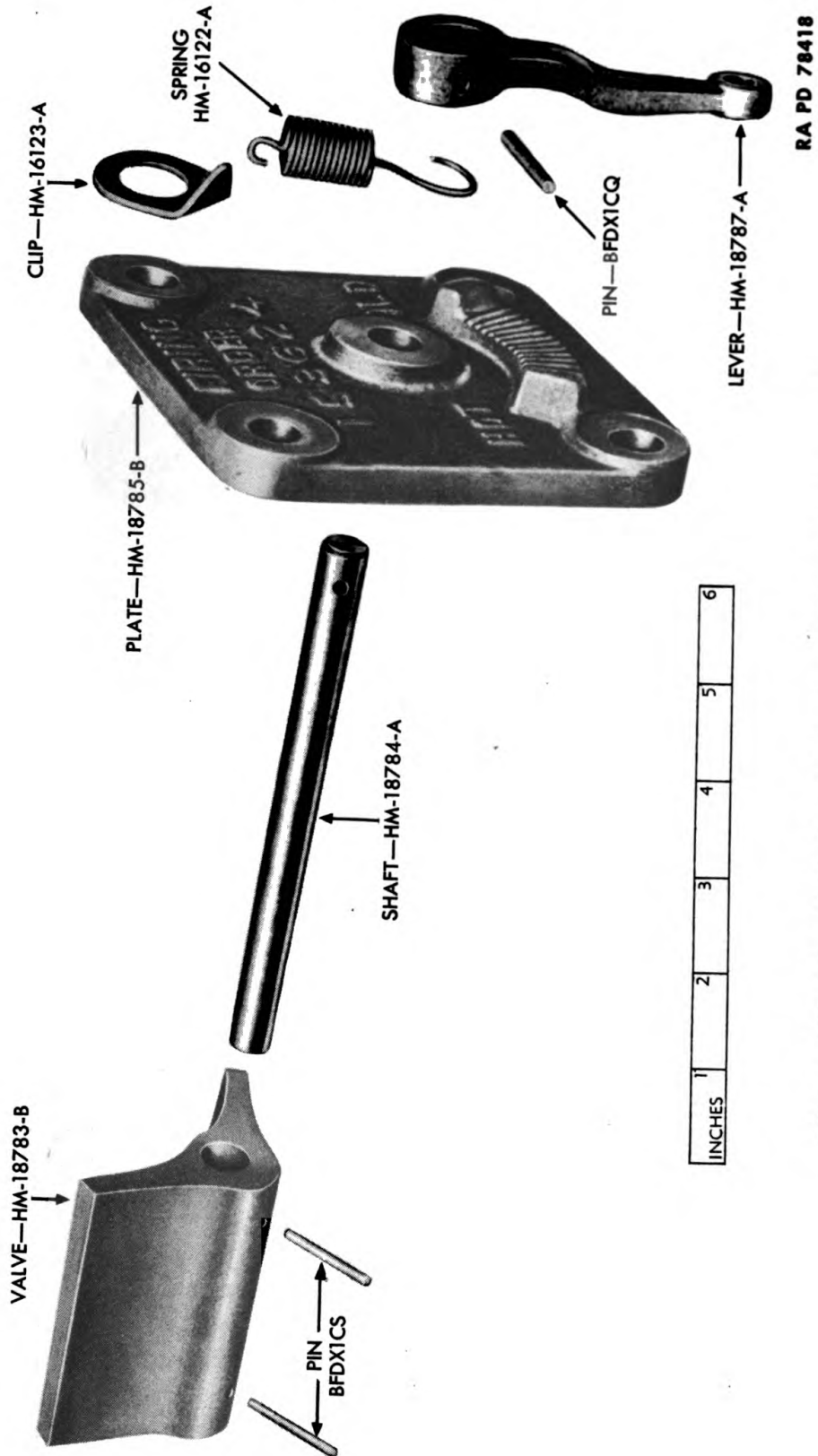


Figure 46—Manifold Disassembled

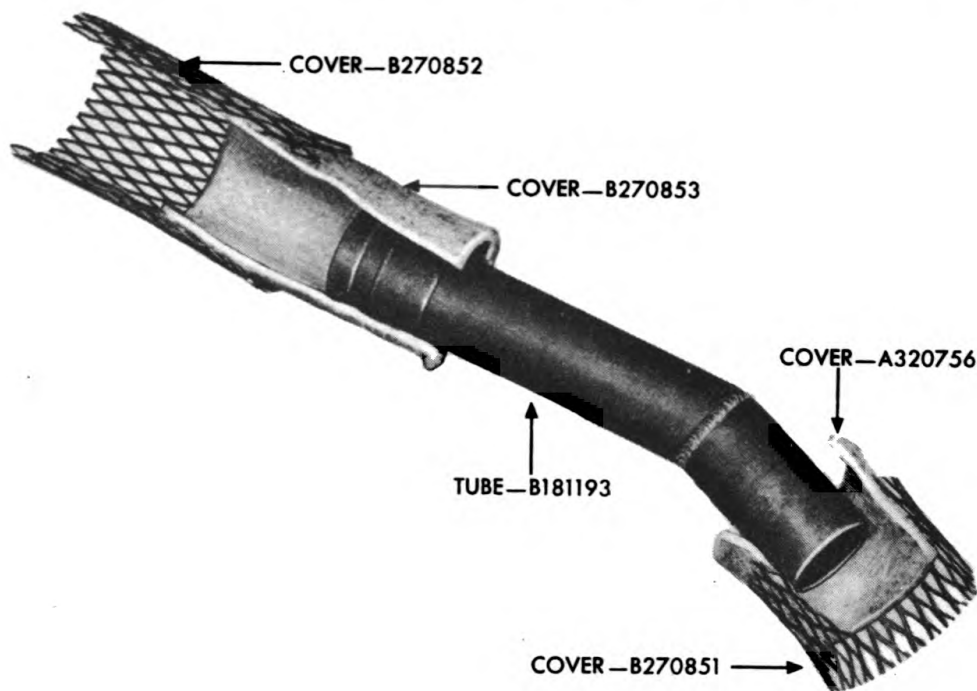
ENGINE AND ACCESSORIES



RA PD 78418

Figure 47—Manifold Heat Control Valve Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78210

Figure 48—Exhaust Tube Disassembled

- (5) Hook spring onto clip and shaft.
- (6) Place gasket and plate assembly in position. Slip clip onto stud at upper right-hand corner of plate.
- (7) Install and tighten four nuts which attach plate assembly to manifold.

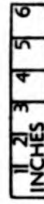
41. EXHAUST TUBE.**a. Disassembly (fig. 48).**

- (1) Slide asbestos insulating covers and expanded metal lath insulation covers from tube.
- (2) Unhook insulation covers and remove insulating covers from them.

b. Inspection and Repair.

- (1) Clean sheet metal with wire brush.
- (2) Examine sheet metal for dents serious enough to restrict passages of gases. Also examine for cracks or breaks.
- (3) Examine asbestos covers. If torn sufficiently to prevent proper insulation, replace cover.
- (4) Examine expanded metal lath insulation cover. Replace covers if broken.

ENGINE AND ACCESSORIES



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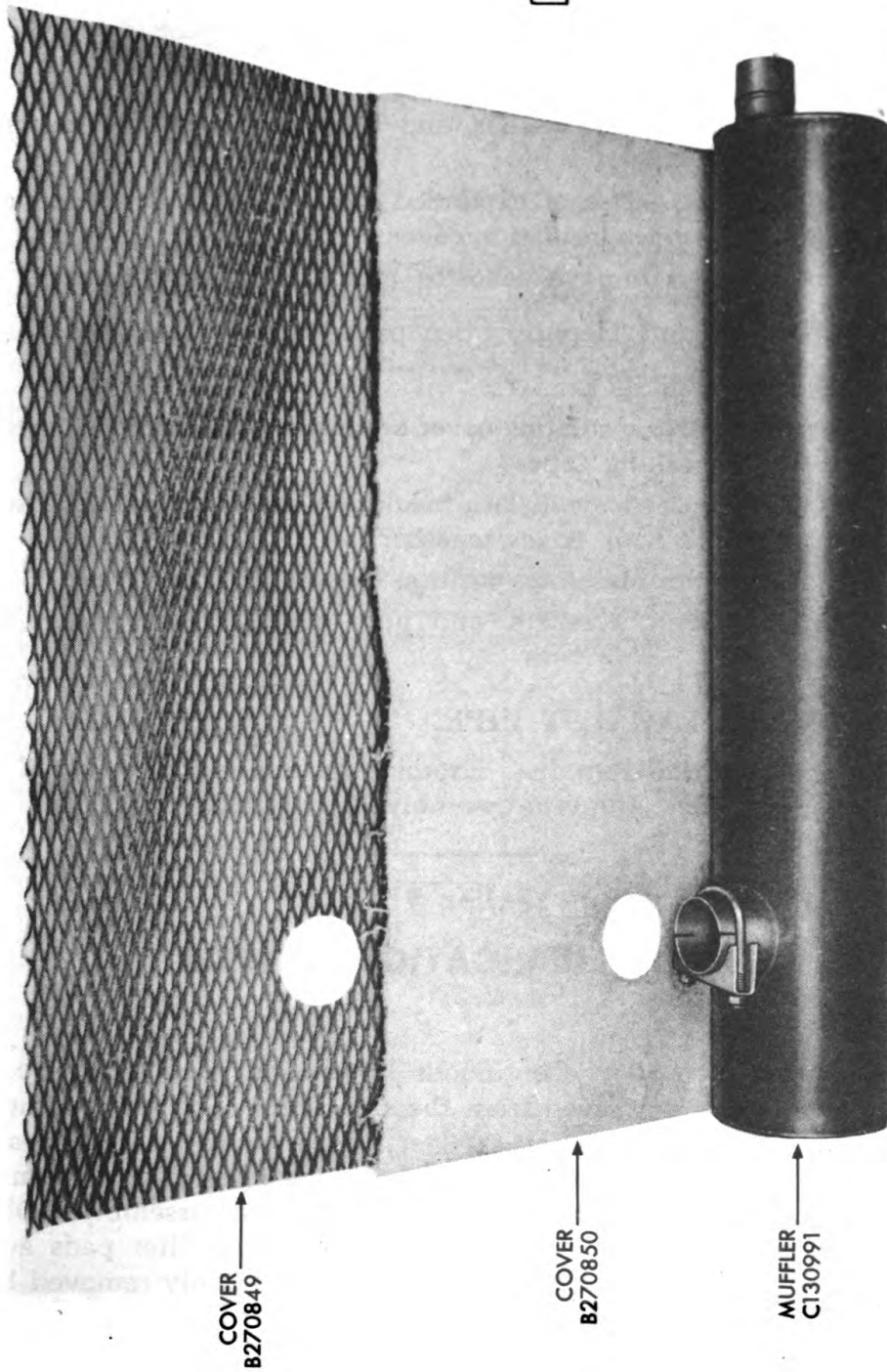


Figure 49—Muffler Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18**c. Assembly (fig. 48).**

(1) Wrap top and bottom pieces of asbestos insulating cover around exhaust pipe.

(2) Wrap expanded metal lath insulation cover around asbestos, and hook edges of metal together.

42. MUFFLER.**a. Disassembly (fig. 49).**

(1) Remove two nuts, washer, and U-bolt from muffler clamp. Lift clamp from muffler.

(2) Unhook two edges of expanded metal lath insulation cover from each other. Remove insulation cover.

(3) Unwrap and remove asbestos muffler insulating cover.

b. Inspection and Repair. See paragraph 41 b.**c. Assembly (fig. 49).**

(1) Wrap asbestos insulating cover around muffler. Hold asbestos in position with masking tape.

(2) Wrap expanded metal lath insulation cover around asbestos insulating cover and hook edges together.

(3) Place muffler clamp in position on muffler split sleeve.

(4) Install U-bolt, washers, and nuts which secure clamp to muffler sleeve.

43. FLEXIBLE EXHAUST PIPE.

a. Inspection and Repair. Examine flexible tubing to see if it is broken or crushed. Replace assembly if damaged.

Section V**ENGINE LUBRICATION SYSTEM****44. DESCRIPTION.**

a. General (fig. 50). Continuous lubrication is provided by a submerged type pump driven from the camshaft. The pump draws its oil through a screen type oil strainer from a sump in the oil pan. The oil is pumped under pressure through the filter pads and into the outlet pipe located in the center of the filter pad assembly. Dirt and foreign substances collect on the outside of the filter pads and drop to the bottom of the filter where they can be easily removed by means of the drain plug. Rear and center camshaft bearings, cylinder walls, pistons, and valve tappets are all lubricated by oil thrown from the main and connecting rod bearings.

ENGINE AND ACCESSORIES

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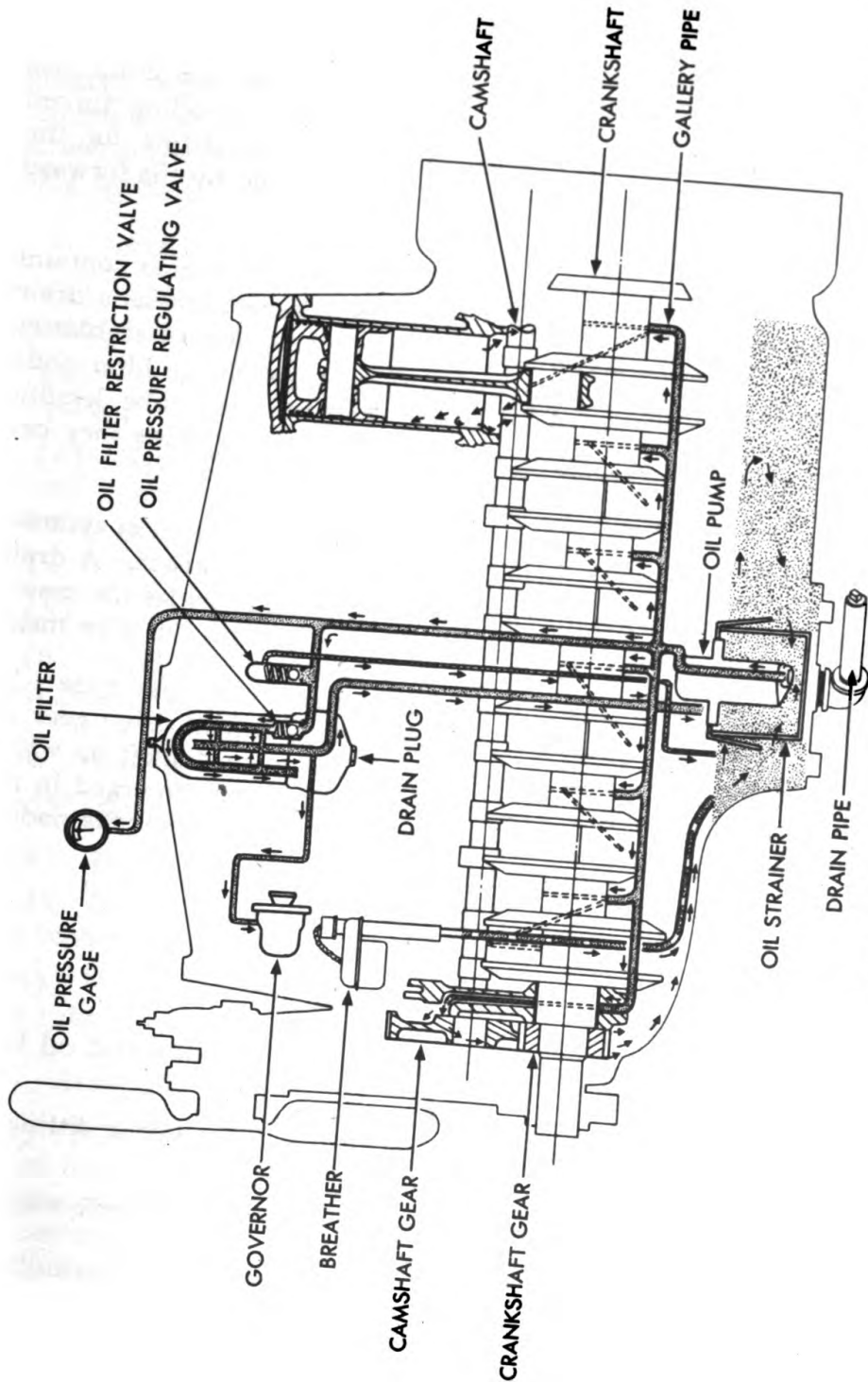


Figure 50—Engine Oil System Diagram

ORDNANCE MAINTENANCE—GENERATING UNIT M18

b. Crankcase Ventilation. A crankcase ventilating metering valve is installed on the right side of the engine, toward the rear (fig. 19). One end is connected to an opening in the crankcase, and the other end is connected to an opening in the intake manifold. The crankcase breather is located on the left side of the engine. The metering valve is a spring-loaded, one-way valve, operated by high manifold vacuum. Its action is to draw vapors from the crankcase and pass them off through the intake manifold, providing forced ventilation of the crankcase by this means, as a substitute for the forced ventilation which would ordinarily be produced by the forward motion of the vehicle.

c. Oil Filter (fig. 50). The oil filter is a casing which contains felt pads about a center tube and a base. The base contains a drain plug and an adjustable spring and plunger type pressure regulating valve. The oil is pumped under pressure up through the filter pads. It comes out at the top and flows down through a filter tube, leaving dirt and foreign substances at the bottom of the filter where they can be easily removed by means of the drain plug.

d. Oil Strainer (fig. 50). The oil strainer is a wire mesh cylinder welded to a removable cap at the bottom of the crankcase. A drain pipe attached to an elbow in the center of the cap provides the means for draining oil. The oil pump draws the oil through the wire mesh.

e. Oil Pump (fig. 50). The oil pump is a spur gear type. Its principal parts are a body, a long shaft with a helical drive gear on top end and a spur gear on the other end, and a short shaft on which the other spur gear rides. The two spur gears are submerged in the oil. As these meshing gears rotate, oil is set in motion by the paddle action of their teeth, and forced through the system.

45. OIL FILTER.

a. Removal (fig. 51).

(1) Remove sludge drain screw and drain sludge and oil from oil filter.

(2) Disconnect oil pressure gage tubing from elbow fitting on back of oil filter base.

(3) Remove the four filter-to-crankcase bolts and lock washers. Lift filter and gasket from cylinder block.

b. Disassembly (figs. 52 and 53).

(1) Screw retainer fitting from top of shell. Lift washer from top of shell. Screw nut from fitting. Lift shell and gasket from base.

ENGINE AND ACCESSORIES

(2) Screw filter assembly from base. From bottom of filter tube, remove nut, spring, washer A317524, washer A317530, washer A317531, 17 felt washers which make up element, and spring A317526. From top of tube, unscrew threaded washer and male nut. Empty ball and spring A317522 from top of tube.

(3) From rear of base, unscrew elbow; from bottom of base, unscrew drain plug and remove plug gasket; from left side of base, remove acorn nut, gasket, adjusting screw lock nut, gasket, adjusting screw, spring, and plunger; and from tube on top of base, remove plug, spring, and ball.

c. Inspection.

(1) Clean all parts in dry-cleaning solvent, and dry with compressed air.

(2) Inspect all springs to see if any are bent, broken, rusted, or corroded.

(3) Examine all screws, nuts, plugs, washers, retainer, and valves to see if any are broken, bent, burred, noticeably worn, or if any have stripped threads.

(4) Inspect shell and base for cracks or breaks.

(5) Check condition of plunger and plunger seat.

(6) Examine felt washers to see if they are matted or saturated with gummy substance.

d. Repair.

(1) Remove burs from all parts with a fine mill file.

(2) Replace all gaskets.

(3) Clean felt washers in dry-cleaning solvent, if possible. Otherwise replace them.

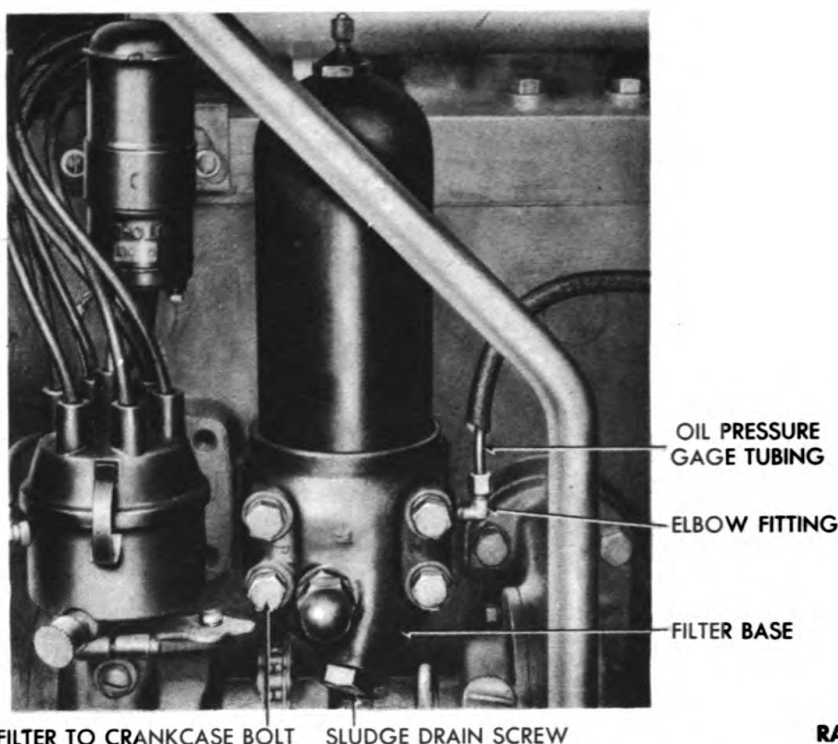
(4) Remove obstructions from all passages and holes in base and filter tube with wire ramrod or compressed air.

e. Assembly (figs. 52 and 53).

(1) Insert plunger (flat end first) and spring A317510 into valve hole on left side of base. Screw adjusting screw in over spring to the approximate location it was before disassembly. Install gasket and lock nut on adjusting screw. Install gasket and acorn nut fingertight on adjusting screw.

(2) Install gasket and drain screw into bottom of base and elbow fitting on rear of base. Tighten elbow so it points up. In tube on top of base, install ball, spring A317511, and plug.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78585

Figure 51—Oil Filter Installed

(3) Into top of element tube A317529, install spring A317522, ball, and nut. Screw threaded washer A317523 onto top of tube. Onto lower end of tube, install spring spacer A317526, 17 felt washers which compose purifier, washer A317531, washer A317530, washer A317524, spring A317525, and nut respectively. Screw element assembly into base.

(4) Position shell gasket and shell on base. Install gasket and retainer on element tube at top of shell. Screw cap onto retainer.

f. Installation (fig. 51).

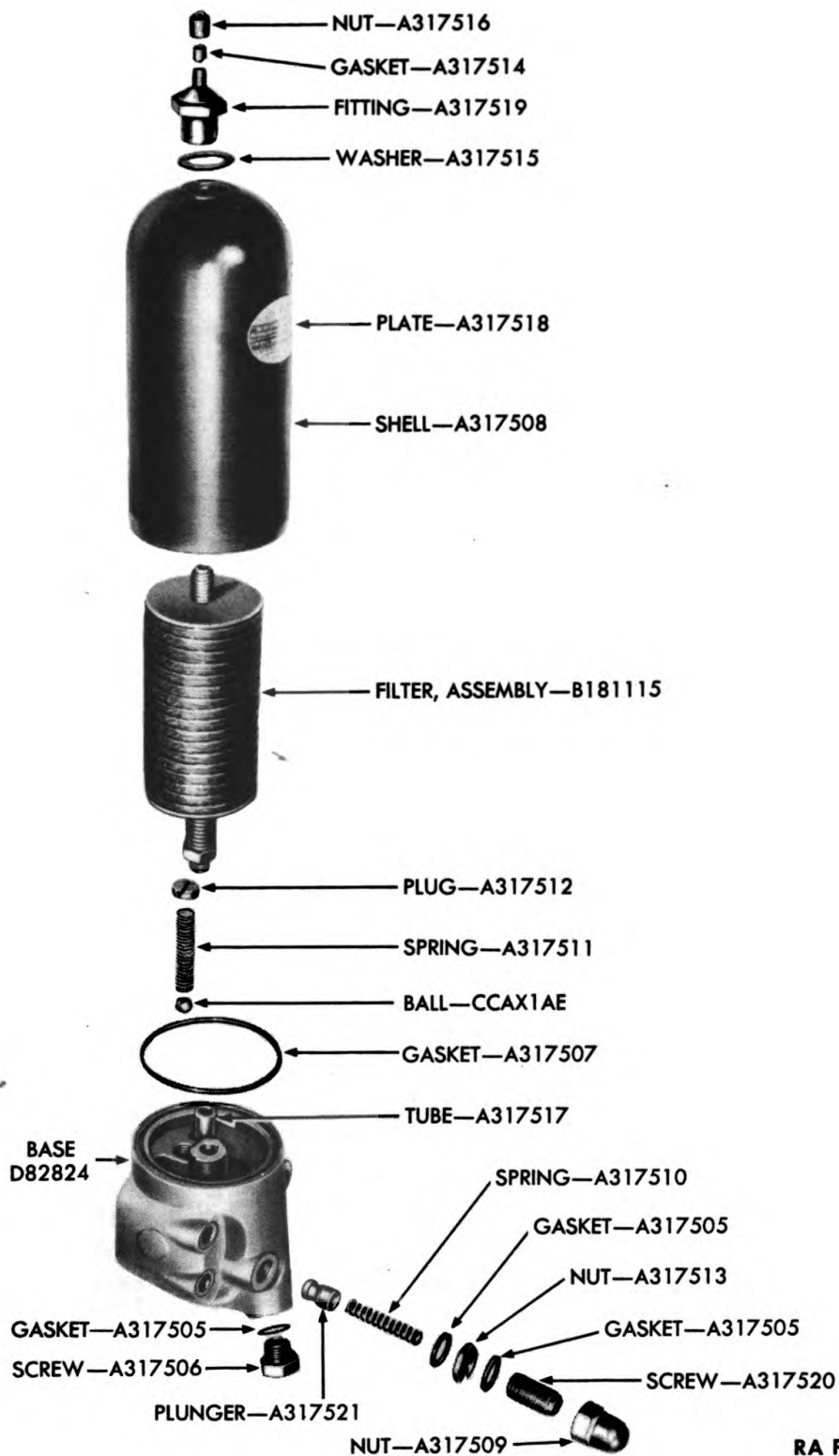
(1) Position new gasket and oil filter assembly on cylinder block. Install the four lock washers and bolts which attach filter assembly to block.

(2) Connect oil pressure gage tubing to elbow on rear of filter base.

(3) Start engine, allow to warm up, and adjust oil pressure to 25 pounds.

(4) Check quantity of oil in crankcase and add if necessary.

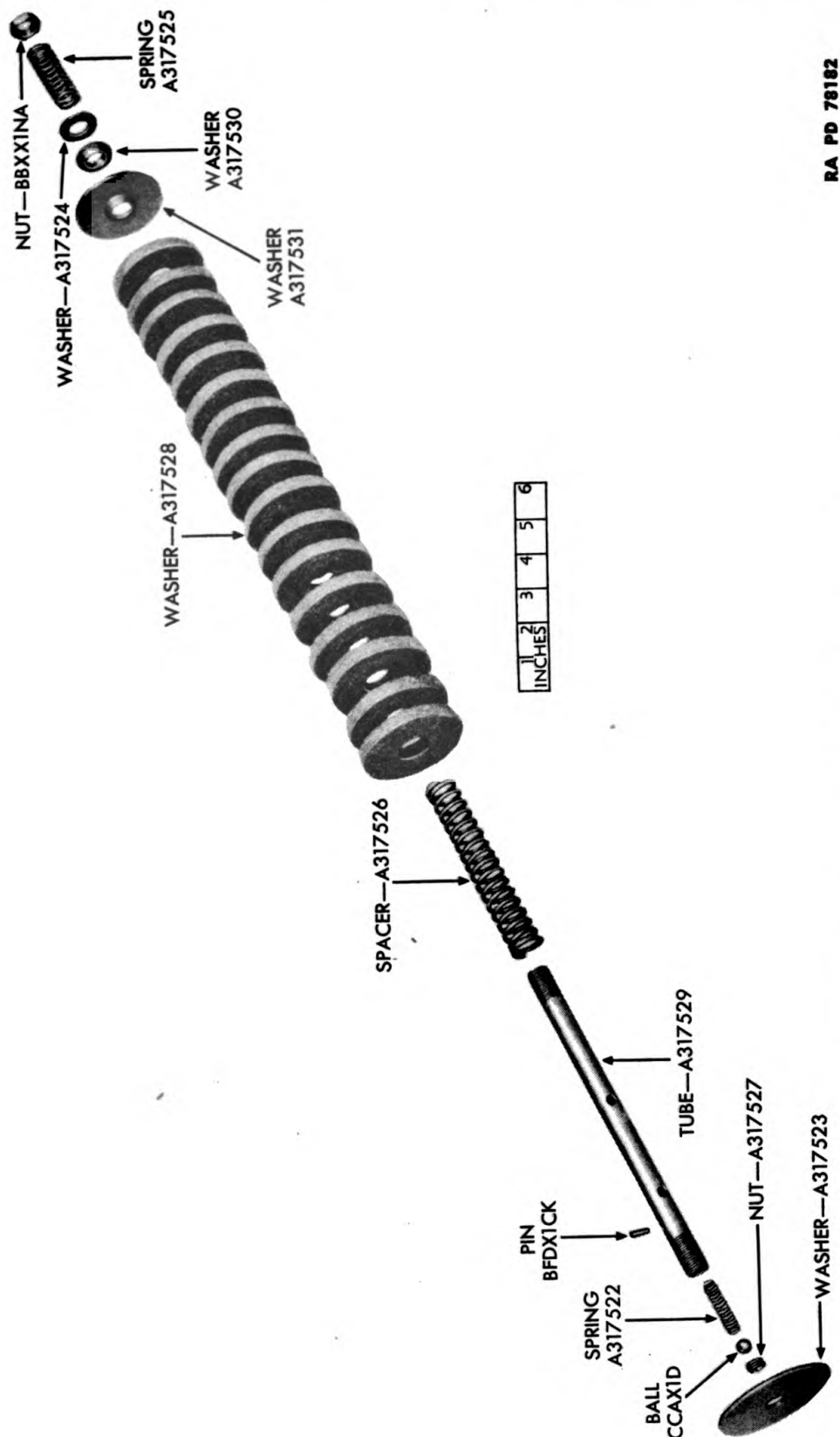
ENGINE AND ACCESSORIES



RA PD 78380

Figure 52—Oil Filter Disassembled

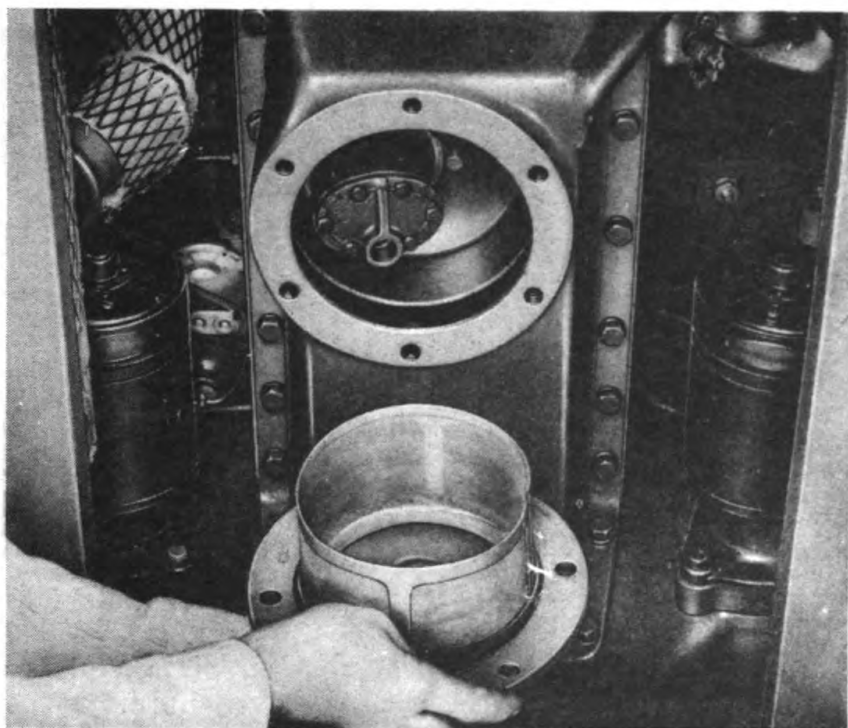
ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 79182

Figure 53—Oil Filter Element Disassembled

ENGINE AND ACCESSORIES



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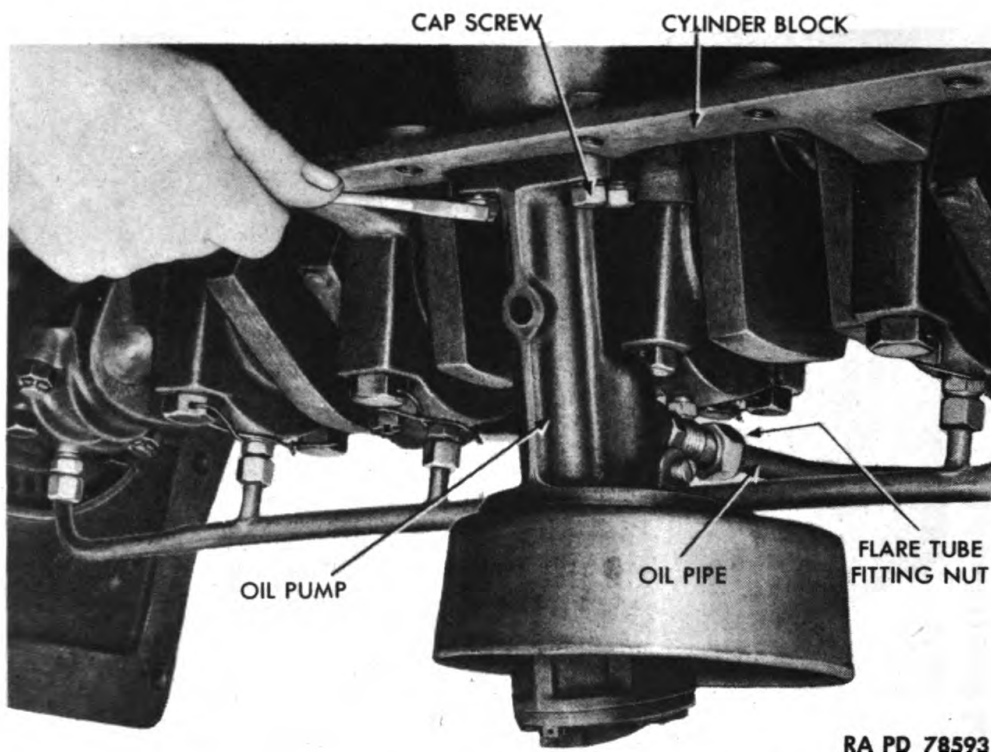
Figure 54—Engine Oil Strainer Removal**46. OIL STRAINER.****a. Removal (fig. 54).**

- (1) Drain oil from engine.
- (2) Hoist front end of unit and remove front bottom main frame cover.
- (3) Screw oil drain pipe from elbow on underside of strainer.
- (4) Remove cap screws and lock washers which attach strainer to oil pan. Lift strainer and gasket from oil pan.

b. Disassembly. Screw elbow from strainer.**c. Inspection and Repair.**

- (1) Wash parts in dry-cleaning solvent, and dry with compressed air. Blow wire mesh clean.
- (2) Inspect wire mesh to see if it is torn. Note condition of threads on elbow and female threads in strainer. Scrape all dirt and sludge from frame, screen, and elbow. Examine attaching cap screws and lock washers to see if any are bent, broken, stripped, or sprung. Inspect gasket to see if it is torn, compressed, or otherwise damaged.
- (3) File burs off all parts. Replace bent, broken, sprung, or stripped parts. Replace gasket if damaged.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78593

Figure 55—Oil Pump Removal

d. **Assembly.** Apply white lead pigment to threaded portion of elbow. Screw elbow tightly into underside of strainer so it points midway between two adjacent cap screw holes.

e. **Installation** (fig. 54).

(1) Position gasket on strainer. Position strainer to oil pan so that elbow points to left. Install the six lock washers and cap screws which attach strainer to oil pan.

(2) Screw oil drain pipe tightly into elbow.

(3) Install front bottom main frame cover and lower unit to ground.

(4) Install engine oil and inspect for leaks.

47. OIL PUMP.

a. **Removal** (fig. 55).

(1) Remove engine from unit (par. 58 c) and block assembly high enough to remove oil pan. Removal of engine is necessary, as pan cannot be removed due to structural interference.

(2) Remove oil pan from engine.

(3) Disconnect oil pipe from oil pump by unscrewing flare tube fitting nut.

ENGINE AND ACCESSORIES

(4) Remove the four cap screws and lock washers which attach pump to cylinder block. Lift pump from engine.

b. Disassembly (fig. 56).

(1) Remove safety wire from screws which attach baffle shell to pump body. Remove screws and lift shell and gasket from body.

(2) Remove safety wire from screws which attach cover to underside of pump. Remove screws and lift cover from pump.

(3) Remove snap rings which hold spur gears to shafts. Pull gears from shafts. Pull idler shaft from pump body. Tap key from keyway in each shaft.

(4) Pull drive shaft from top of body. Slide washer from shaft. Drive out pin which holds drive gear to shaft. Press gear from shaft.

(5) Screw plug and oil tube fitting from body.

c. Inspection.

(1) Wash all parts in dry-cleaning solvent, and dry with compressed air.

(2) Inspect drive and idler shafts to see if either is scored or has spread or burred keyways. Test fit of shafts in bushings in body. They should be free running fits without side play.

(3) Examine all gears to see if any are chipped, nicked, broken, burred, or have spread keyways.

(4) Examine keys to see if any are bent or burred.

(5) Inspect body, cover, and shell to see if they are cracked, broken, or burred. Examine threads tapped in screw holes.

(6) Inspect screws, snap rings, and pin to see if any are bent, broken, or burred. Examine threads on screws to see if they are stripped.

(7) Examine shell gasket to see if it is torn or crushed.

d. Repair.

(1) Remove burs from all parts with a fine mill file.

(2) Replace gears which are chipped, nicked, broken, or which have spread keyways.

(3) Clean up slightly damaged screw-hole threads with a thread tap. Replace parts having stripped threads.

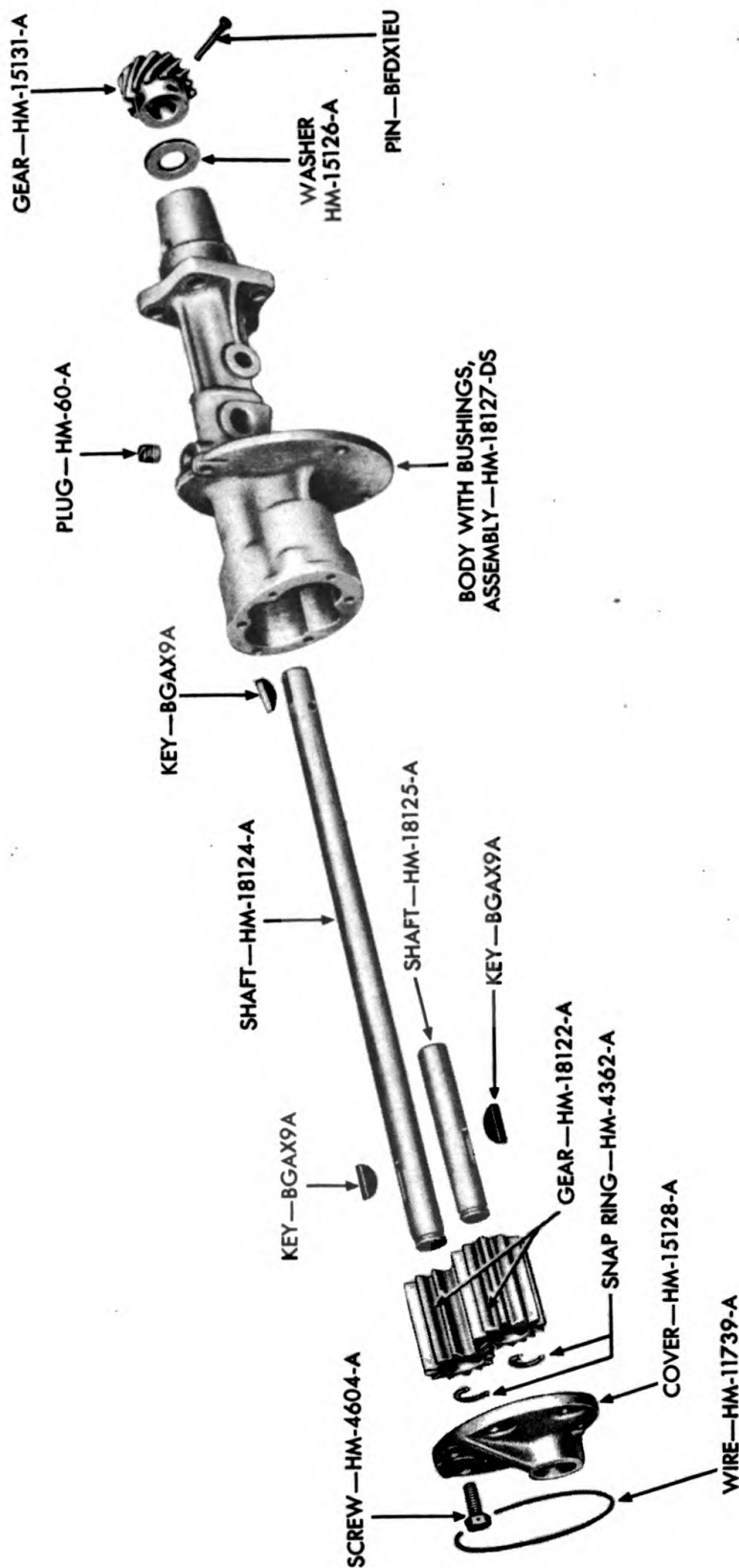
(4) Replace shell gasket if torn or crushed.

e. Assembly (fig. 56).

(1) Screw plug and oil tube fitting into their respective bosses in body.

(2) Tap key into position in keyway in top end of drive shaft. Press helical drive gear onto shaft and key. Drive pin through gear

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 79577

Figure 56—Oil Pump Disassembled

ENGINE AND ACCESSORIES

and shaft, and peen pin. Slide drive shaft into position in body. Tap key into keyway on lower end of shaft and tap spur gear onto key and shaft. Install snap ring on end of shaft.

(3) Tap key to seat in keyway in idler shaft. Insert shaft into its bushing within body. Tap spur gear on shaft and key. Install snap ring on end of shaft.

(4) Position cover on underside of body. Install screws which attach cover to body. Install safety wire through heads of screws.

(5) Position shell gasket and baffle shell on pump body. Install screws which attach shell to body. Install safety wire through heads of screws.

f. Installation (fig. 55).

(1) Place oil pump in position against machined surface on underside of cylinder block. Install the four lock washers and cap screws which attach pump to engine.

(2) Connect oil pipe to fitting in pump.

(3) Install oil pan (par. 72 o (3) and engine (par. 74 b).

Section VI

**ENGINE ELECTRICAL SYSTEM—BATTERY CHARGING
GENERATOR AND REGULATOR; ELECTRIC
BRAKE RECEPTACLE**

48. DESCRIPTION.

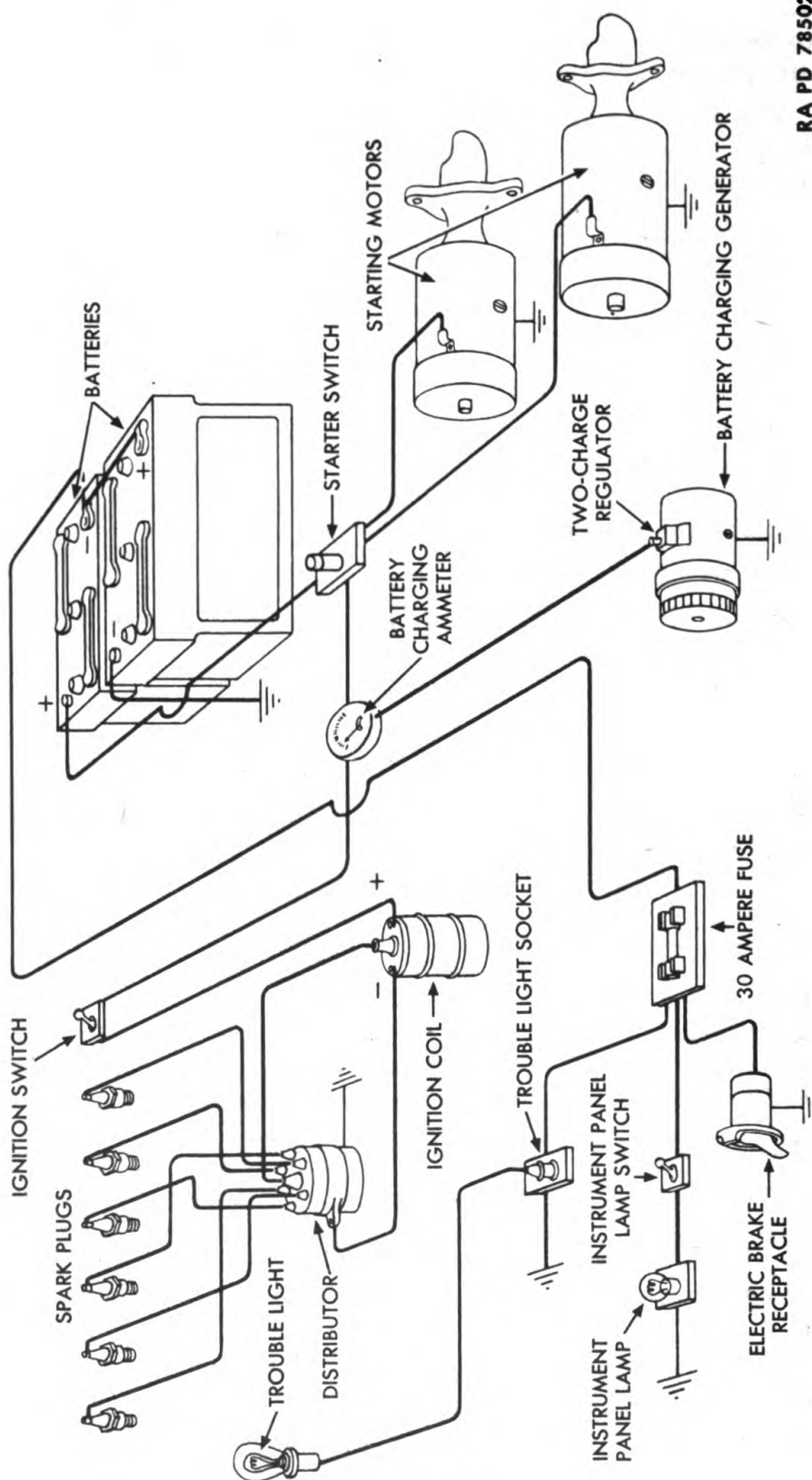
a. Generating Circuit (figs. 57 and 58). The entire battery charging generator circuit consists of a generator, regulator, ammeter, batteries, and connecting wires. The generator and regulator are covered in this section and ammeter in section II of chapter 6.

b. Two-charge Regulator (figs. 59 and 60).

(1) The two-charge regulator is a combination circuit breaker and voltage regulator. The circuit breaker automatically opens and closes the circuit between the generator and batteries. The voltage regulator adjusts generator output to correspond to the need of the batteries.

(2) The circuit breaker consists of an electromagnet and a set of contacts. The electromagnet has two windings. One winding is a shunt coil made of many windings and connected across the generator. The other winding is a series coil made of fewer turns of heavy wire.

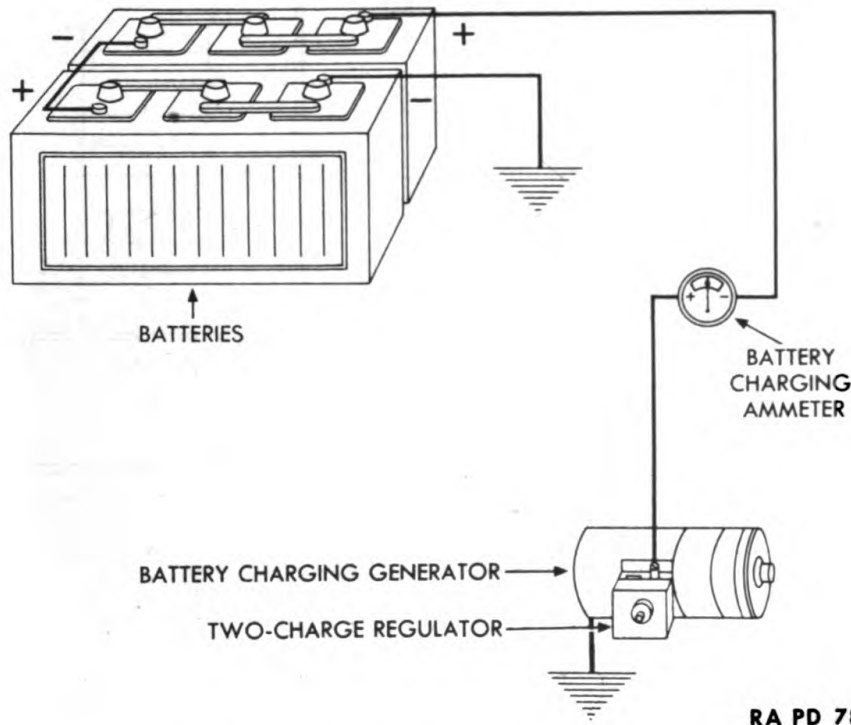
ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78502

Figure 57—Engine Electrical System Diagram

ENGINE AND ACCESSORIES



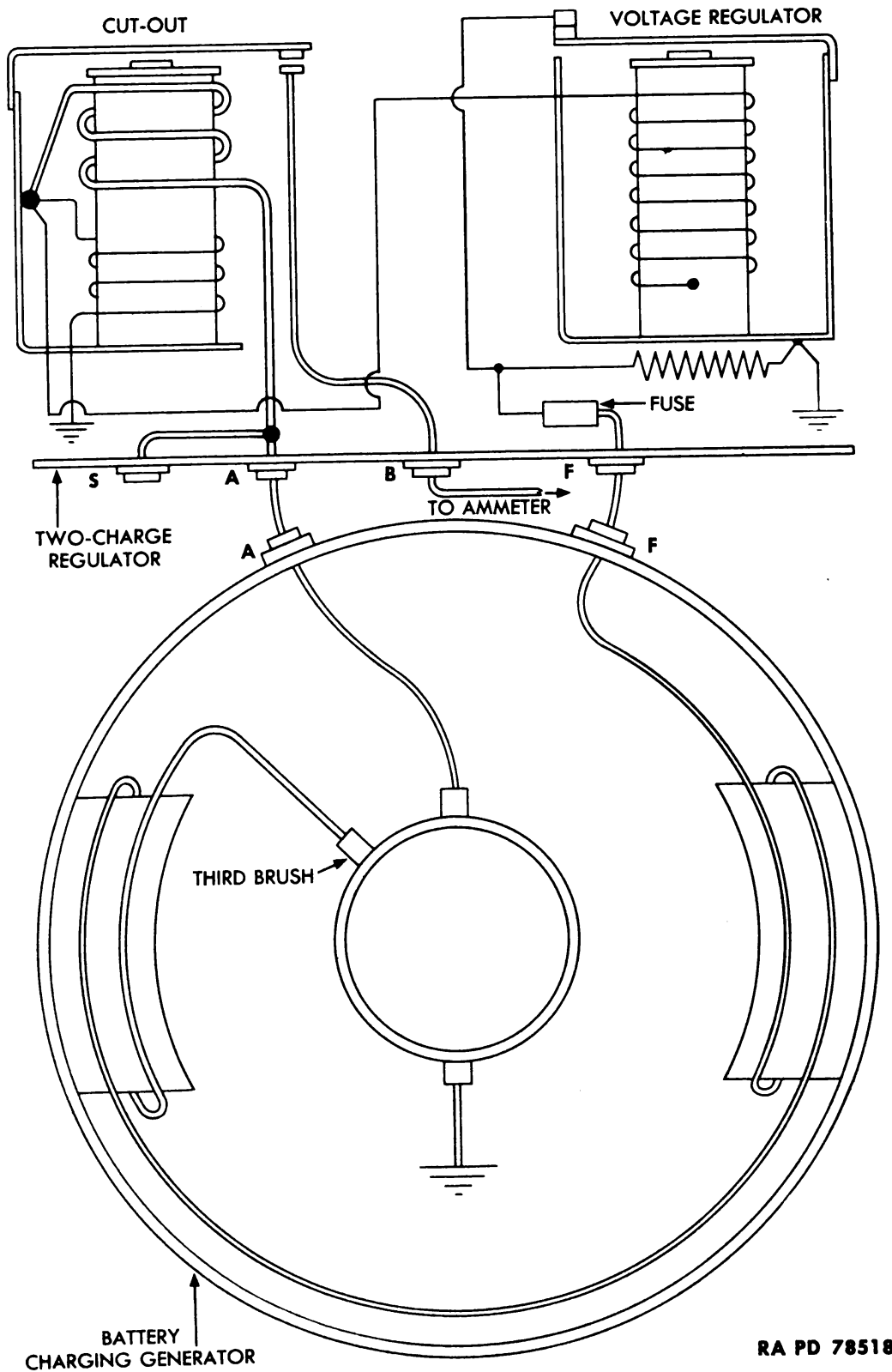
RA PD 78498

Figure 58—Battery Charging Generator Circuit

It is connected in series with generator output. The circuit breaker contacts consist of one movable contact mounted on an armature, operated by the electromagnet, while the other is a stationary contact. These contacts are held open by an armature spring when the engine is not running and at other times when battery voltage exceeds generator voltage. This prevents the battery from discharging through the generator. When the engine is started, the generator builds up voltage in the shunt coil. This activates the electromagnet and closes the generator-to-batteries circuit. The current from the generator to the batteries flows through the series coil. This coil also actuates the armature in the same direction as the shunt coil. The pull on the armature is increased, thus, and the contacts are held more tightly together. When the engine slows, the generator loses speed and the generator voltage drops. When it becomes less than the battery voltage, the current reverses. Then the magnetism created by the series coil is opposed to the diminished magnetism of the shunt coil. The magnetic pull is decreased, thus, and the spring again opens the contacts.

(3) The voltage regulator operates by inserting a resistance in the generator field circuit when the voltage reaches a predetermined value. The voltage regulator consists of an electromagnet, a set of

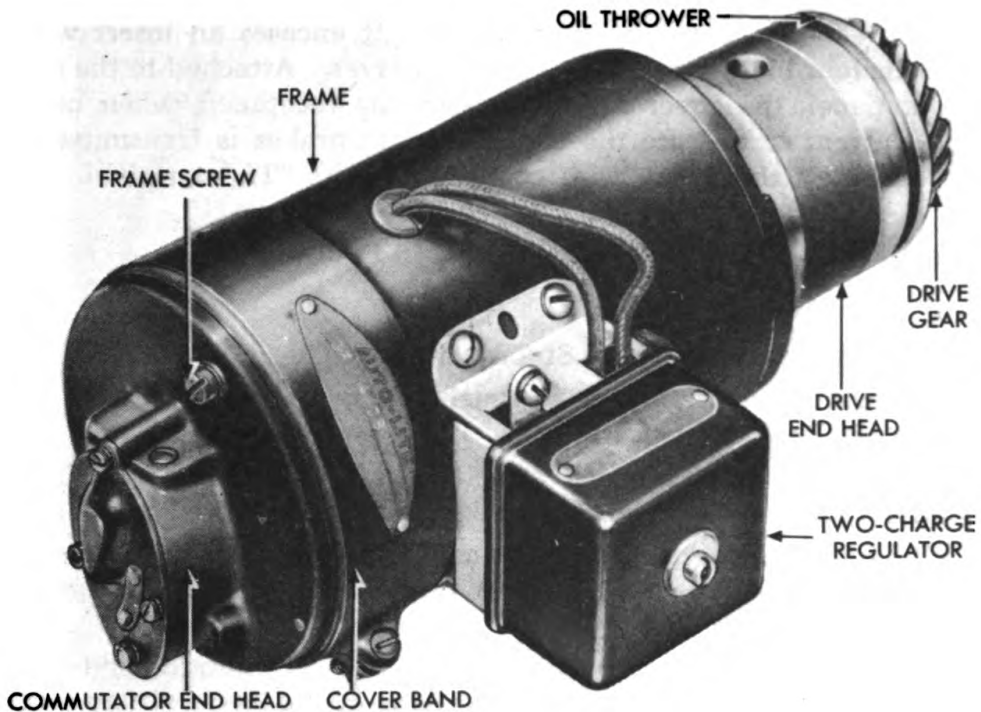
ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78518

Figure 59—Battery Charging Generator and Regulator Wiring Diagram

ENGINE AND ACCESSORIES



RA PD 78521

Figure 60—Battery Charging Generator and Two-charge Regulator Assembled

contacts, and a resistor. These parts are arranged so the contacts are normally closed, allowing the generator field circuit to pass through the contacts to ground. When the contacts are opened by action of the electromagnet, the generator field circuit must pass through the resistor to reach ground. The electromagnet is connected in the generator-to-batteries circuit. As the batteries reach full charge, the voltage in the circuit is built up. When the voltage reaches a point sufficient to operate the electromagnet, the points open. Another feature of the voltage regulator is the magnetic bypass which compensates for temperature changes. It consists of a small piece of nickel-iron across the top of the magnetic core of the electromagnet. The magnetic conductivity of this metal gradually increases as the temperature decreases. At low temperatures, consequently, much of the magnetic pull of the core, which would normally affect the cutting-in of the field resistance, flows through the bypass instead of the regular armature. This results in a higher generator voltage being required to cut in the field resistance.

c. **Electric Brake Receptacle** (figs. 1 and 79). The electric brake receptacle consists of a four-blade receptacle with a spring-loaded cover. The receptacle is of metal construction and is cylindrical in shape. It is attached perpendicularly to the rear side of

ORDNANCE MAINTENANCE—GENERATING UNIT M18

the left rear side panel by four screws. It encases an insert which holds the four blades in equally spaced grooves. Attached to the front side of panel, the cover assembly seals the receptacle when not in use. Current to operate the trailer electric brakes is transmitted to the receptacle through a wire connected to its "TL" terminal.

49. BATTERY CHARGING GENERATOR.

a. Disassembly.

(1) DISASSEMBLE INTO SUBASSEMBLIES (fig. 60).

(a) Loosen nut and screw which clamp cover band to frame. Slide cover band from frame.

(b) Loosen screws which attach field coil lead wires to brush holders. Remove lead wires from screws and remove brushes.

(c) Remove cotter pin and nut from end of armature shaft. Press drive gear from shaft. Tap key from shaft and slide oil thrower from shaft.

(d) Remove the two frame screws. Tap commutator end head. Remove head with brush assemblies from frame.

(e) Tap drive end head to loosen head from frame. Lift head and armature from frame. Press armature from drive end head.

(2) DISASSEMBLE COMMUTATOR END HEAD (fig. 70).

(a) Remove the four screws and lock washers which attach wick cover to head. Lift cover, gasket, and wick from head.

(b) Remove screw and lock washer which attach each of the three brush leads to its brush holder. Slide brushes from holders. Unclip springs and slide arms and springs from brush holder studs.

(c) Remove the two screws and lock washers which secure grounded brush holder to head.

(d) Take out screw which holds Y-spring to head. Lift spring and adjustable third brush holder plate from head.

(e) Pull guard and gasket from inside of head. Press bronze bearing from head.

(3) DISASSEMBLE FRAME (fig. 69). *NOTE: Test field coils (subpar. b (1) below). If tests are satisfactory and coils are in good condition, disassembly of frame is not necessary.*

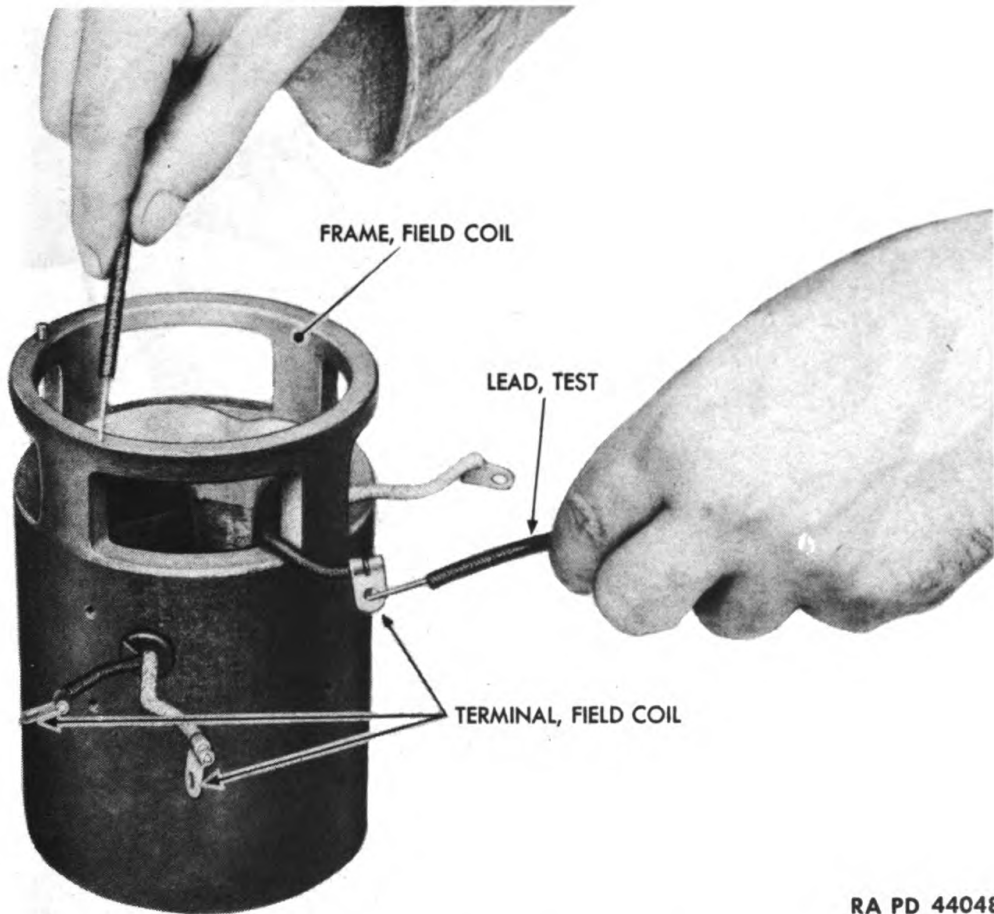
(a) Pull wire leads through rubber bushing (grommet) into frame. Remove bushing from frame.

(b) Unscrew and remove the two pole piece screws (fig. 69).

(c) From inside frame, remove the two pole pieces, two field coils, and one piece of insulation.

(4) DISASSEMBLE DRIVE END HEAD (fig. 68).

ENGINE AND ACCESSORIES



RA PD 44048

Figure 61—Field Coil Test for Ground

(a) Remove the three screws and lock washers which secure the bearing retainer to outside of head. Lift retainer from head.

(b) Press bearing from head.

b. Inspection.

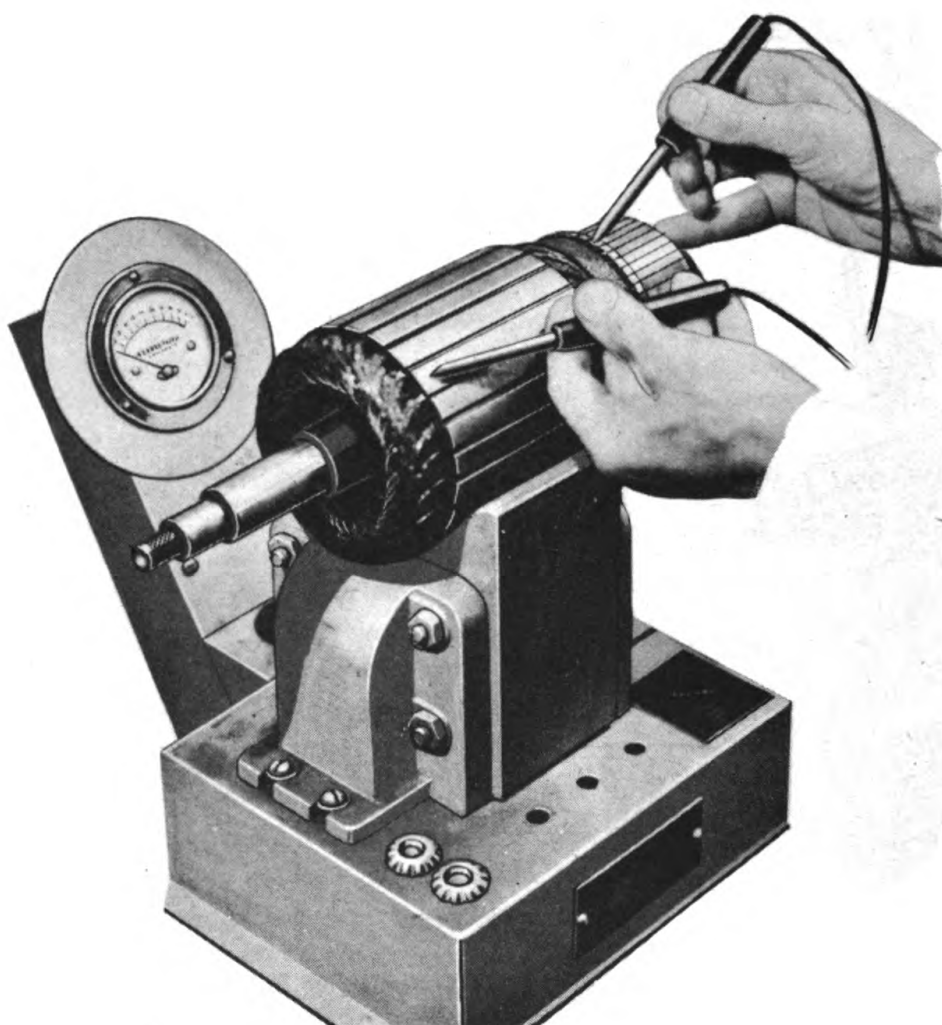
(1) FIELD COILS.

(a) Place test prods of a test lamp on terminals at ends of two leads of a field coil. If test lamp fails to light, an open circuit is indicated. Repeat test on other field coil.

(b) Connect a field coil, battery, and ammeter in series, and note ammeter reading. Repeat test on other field coil. If one coil draws more current than the other, an internal short is indicated in the coil which consumes most current.

(2) ARMATURE.

(a) Place one test prod of a test lamp on armature shaft or core



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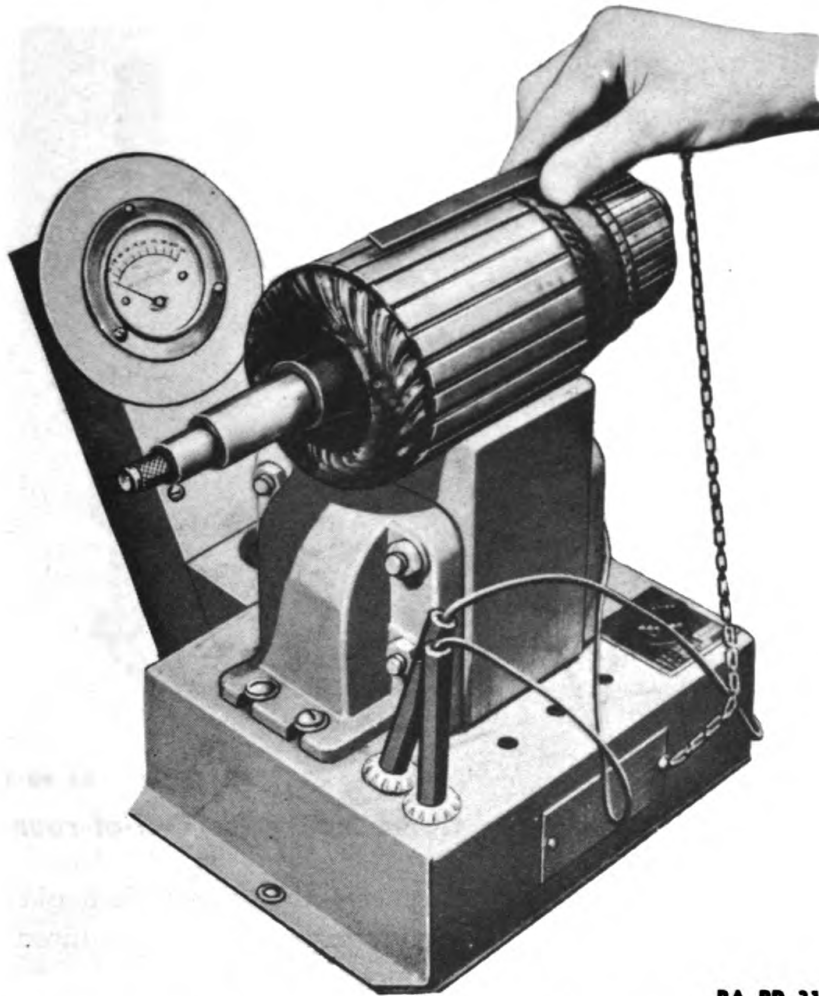
Figure 62—Testing Armature for Grounded Circuit

and the other prod on each commutator bar in turn. If test lamp lights on any of the tests, armature is grounded (fig. 62).

(b) Place armature in a growler. With hacksaw blade over core, rotate armature and test. If saw blade vibrates, a shorted armature is indicted. Clean out all dirt from between commutator bars and repeat test. If short persists, it is in the coils, and armature must be replaced (fig. 63).

(c) Touch probes of a test lamp to each pair of adjacent commutator bars. If lamp fails to light on any test, an open circuit is indicated.

ENGINE AND ACCESSORIES



RA PD 315013

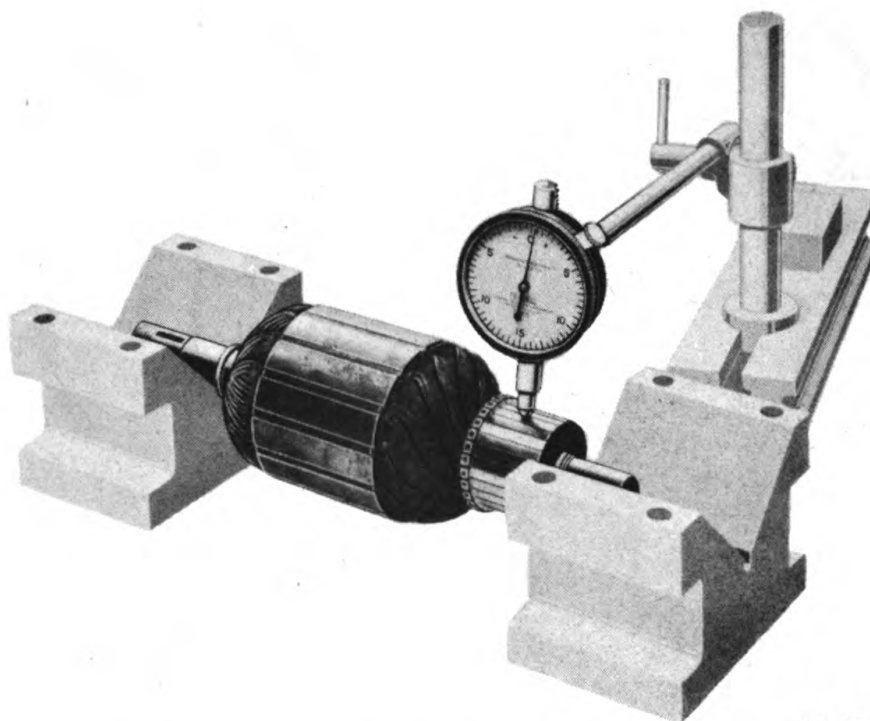
Figure 63—Testing Armature for Shorted Circuit

(d) Check commutator for roughness and high mica. Check armature coil to commutator bar lead wires to see that each is properly soldered to commutator bar. Place armature in V-blocks, mount dial indicator with plunger against commutator, rotate armature, and note reading on indicator. If reading varies 0.0005 inch or more, commutator is out-of-round (fig. 64).

(3) MISCELLANEOUS.

(a) Check fit of armature shaft in commutator end bearing. If fit is loose enough to permit noticeable side play, bearing is worn out.

(b) Clean drive end bearing in dry-cleaning solvent, and dry with compressed air. Do not allow air to spin bearing. Check bearing to see if either race or any ball is worn, chipped, scored, or broken. Rotate bearing slowly and listen for grinding noise which indicates unserviceable bearing.



RA PD 315014

Figure 64—Measuring Commutator for Out-of-round

(c) Check tension of brush springs with spring scale hooked under brush (fig. 65). Fifteen to twenty ounces tension are required to hold new brush snugly against commutator.

(d) Check brushes to see if they are broken. Note amount of wear. They are worn out if no longer at least half their new length.

c. Repair.

(1) Replace generator assembly if unrepairable.

(2) Turn down rough or out-of-round commutator in a lathe. Dress bars with class B flint paper, No. 2/0. Undercut the mica (figs. 66 and 67) and again check armature in growler for short circuit.

d. Assembly.

(1) **ASSEMBLE DRIVE END HEAD** (fig. 68).

(a) Pack drive end bearing with lubricating grease (special) and press into drive end head.

(b) Position retainer over bearing on outside of head. Install the three lock washers and screws which attach retainer to head.

ENGINE AND ACCESSORIES

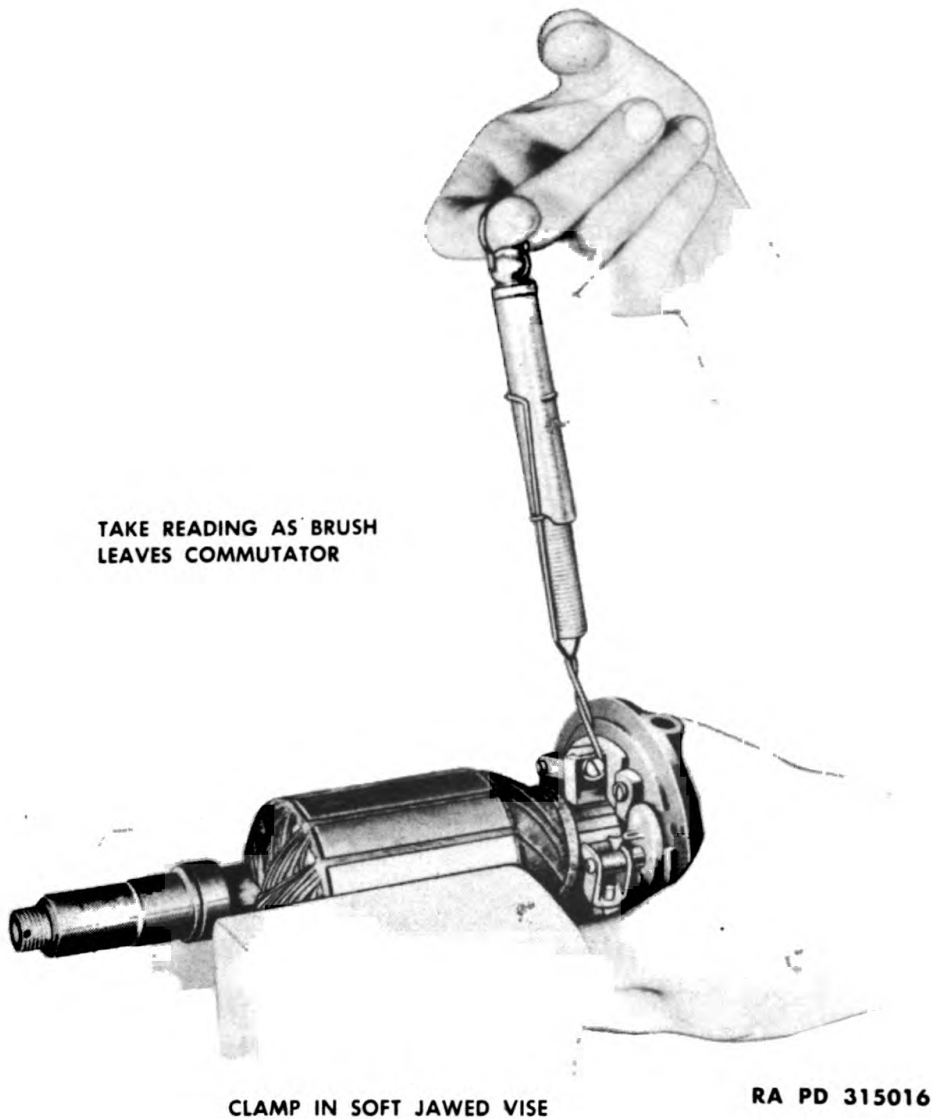
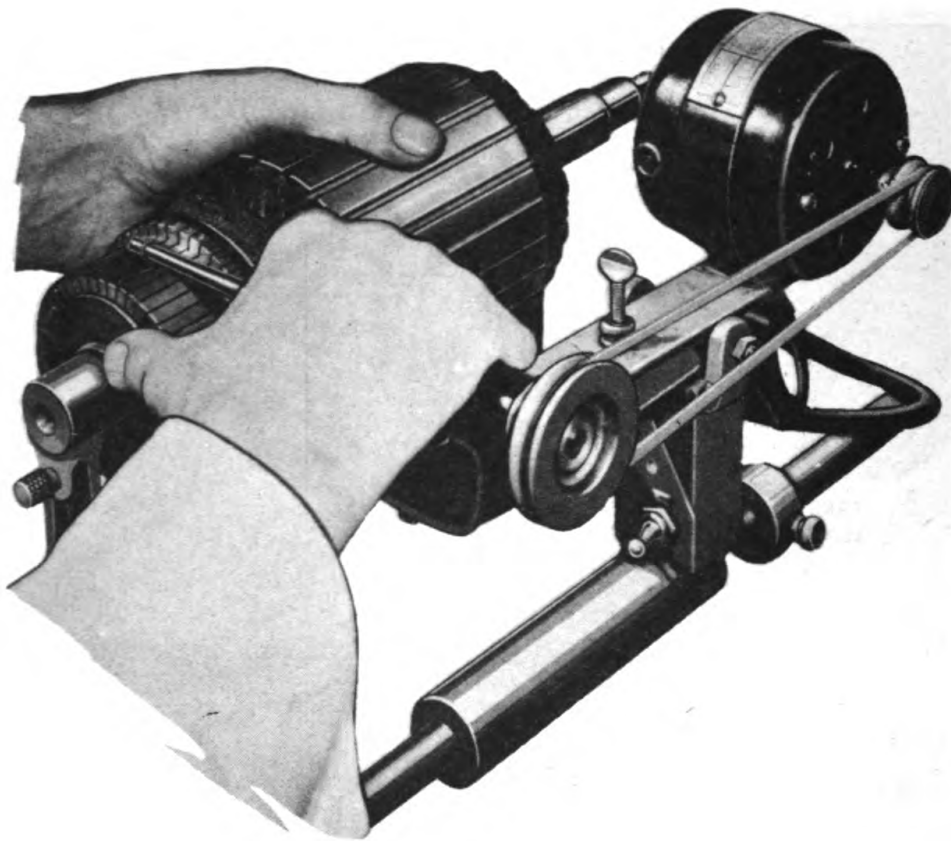


Figure 65—Measuring Brush Spring Tension

(2) **ASSEMBLE FRAME** (fig. 69).

(a) Place insulation in position inside frame. It may be held in place with glue.

(b) Solder together the leads without lugs from the two field coils. Attach coils to inside of frame by inserting a pole piece within each coil, and securing pole pieces to frame with pole piece screws. Tighten screws securely. Bring the single unattached wire from one field coil up through frame bushing hole on top of frame. Carry one of the ends of the gray wire taped to the other field coil up through the same hole. Install rubber bushing around the wires in bushing hole.

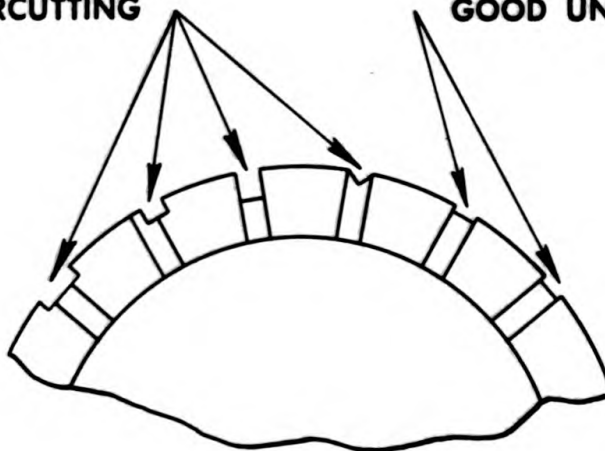


RA PD 315019

Figure 66—Undercutting Commutator Mica With Undercutter

POOR UNDERCUTTING

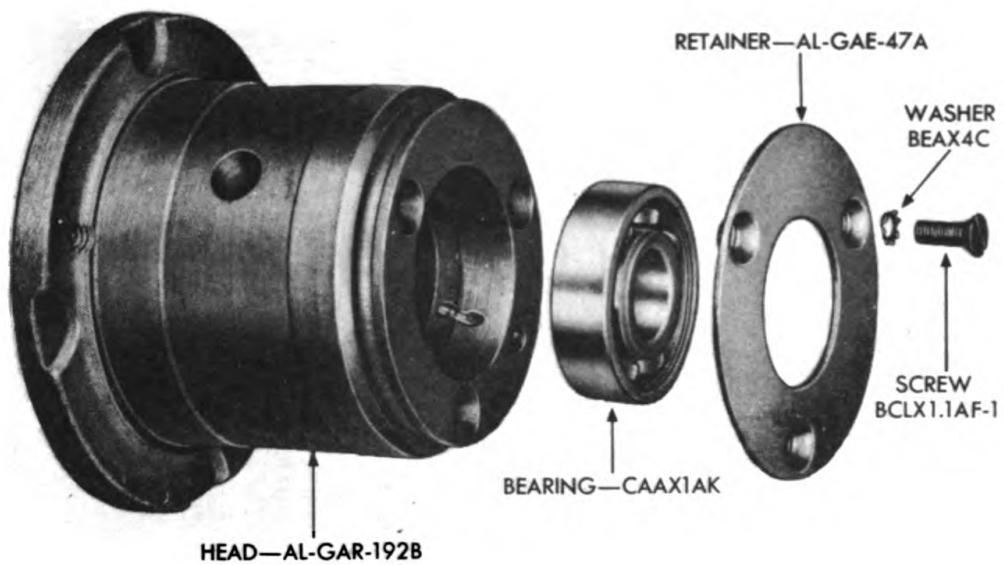
GOOD UNDERCUTTING



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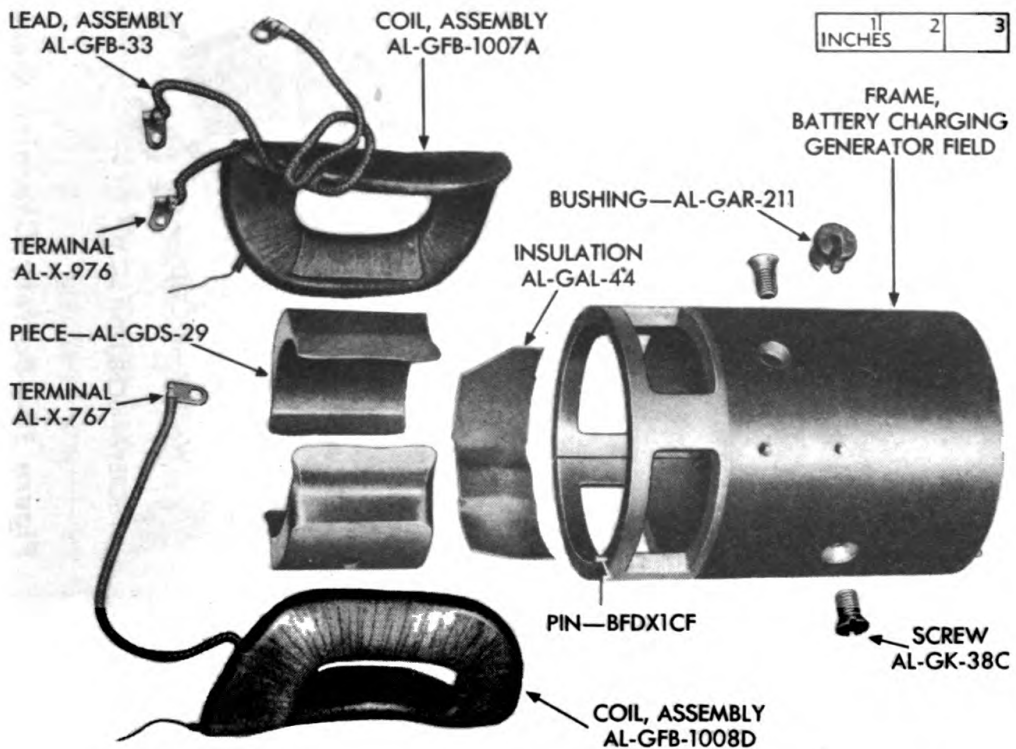
Figure 67—Examples of Good and Poor Undercutting

ENGINE AND ACCESSORIES



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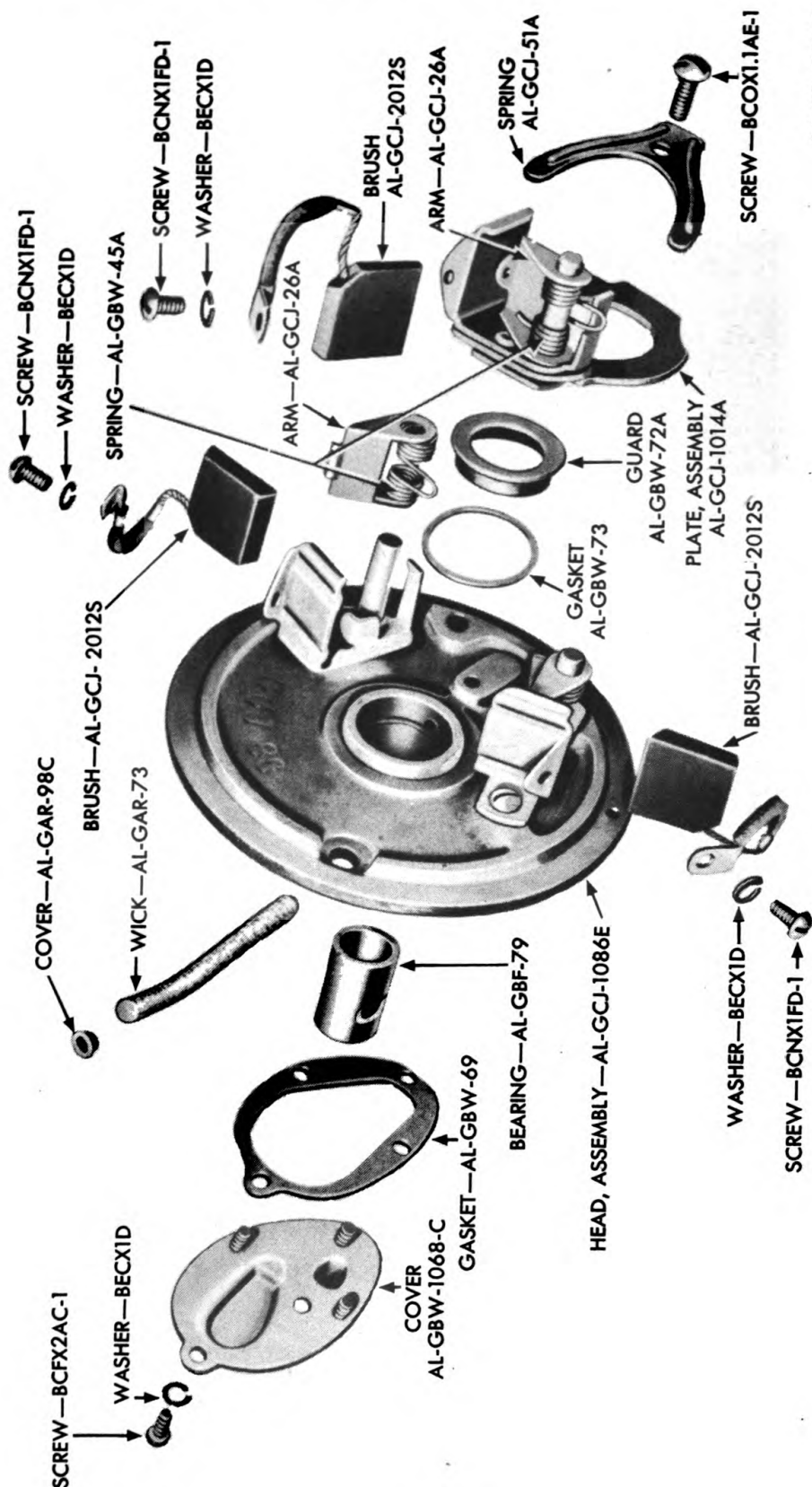
Figure 68—Battery Charging Generator Drive End Head Disassembly



RA PD 78407

Figure 69—Battery Charging Generator Frame Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 86682

Figure 70—Battery Charging Generator Commutator End Head

ENGINE AND ACCESSORIES

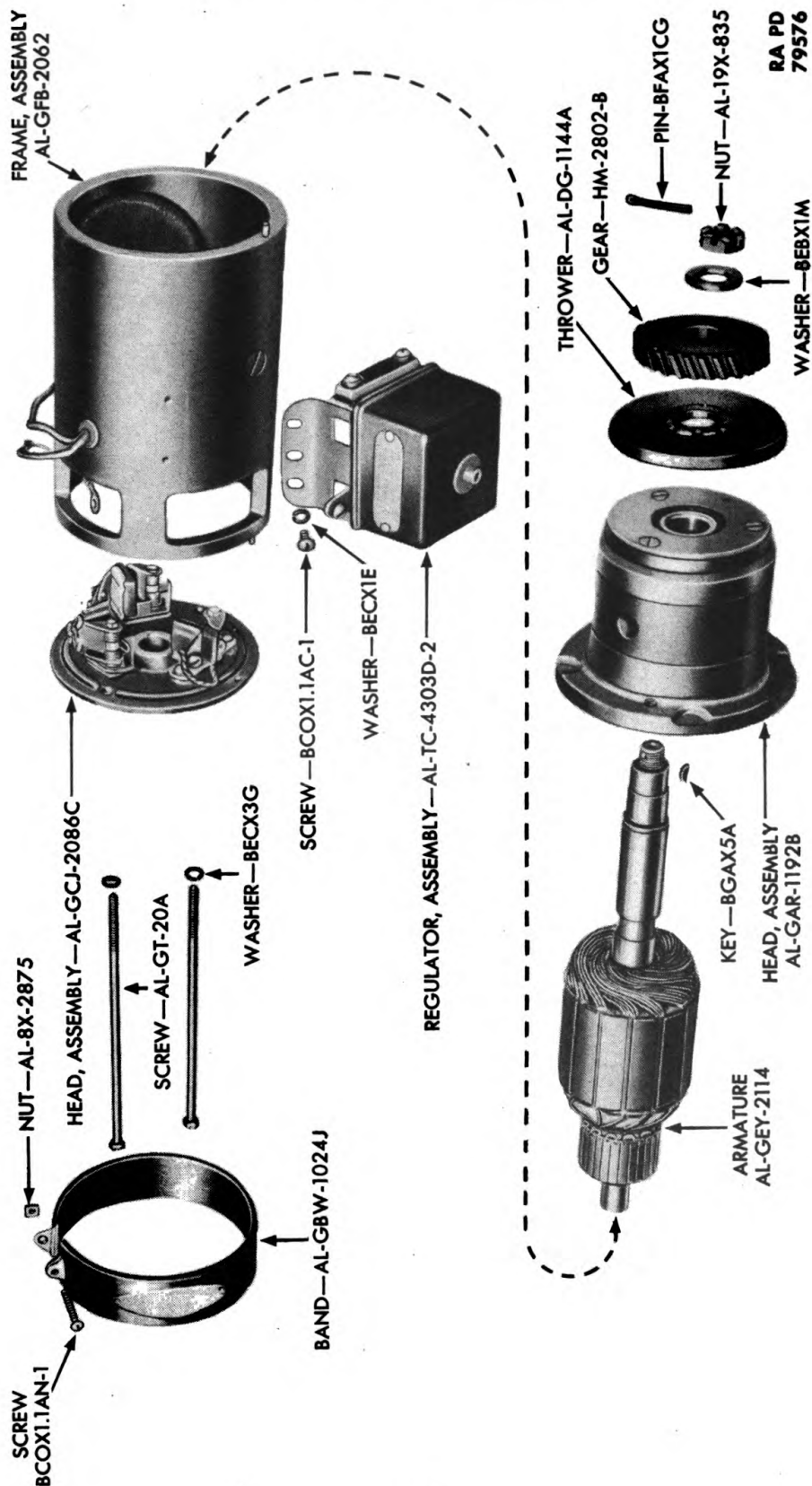
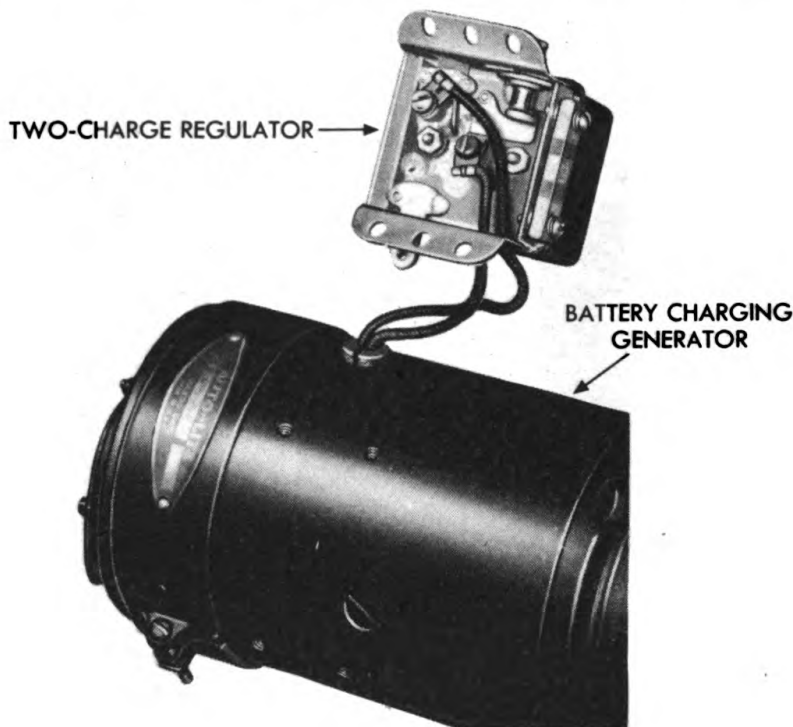


Figure 71—Battery Charging Generator Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78537

Figure 72—Two-charge Regulator Showing Generator Connections

(3) ASSEMBLE COMMUTATOR END HEAD (fig. 70).

(a) Aline oil wick holes in bronze bearing and head. Press bearing into position in head. Position gasket and guard on inside of head and tap to seat.

(b) Position adjustable third brush holder plate and Y-spring on inside of head. Install screw which secures spring to head.

(c) Position grounded brush holder on inside of head. Install the two lock washers and screws which attach holder to head.

(d) Position spring in arm and slide into place on brush holder stud. Repeat process to install two remaining arms and springs. Insert brushes into holders just far enough so arms hold them rigid. Connect each brush lead to its holder with lock washer and screw provided for purpose.

(e) On outside of head, install wick (saturated with oil as prescribed by WDLO), cover gasket, wick cover, four lock washers, and four screws respectively.

(4) ASSEMBLE SUBASSEMBLIES (fig. 71).

(a) Press armature into bearing in drive end head.

ENGINE AND ACCESSORIES

(b) Insert armature into frame from drive end. Aline dowel in frame with dowel hole in drive end head. Tap head to seat on frame.

(c) Position commutator end head on frame, alining dowel on frame with dowel hole in head. Tap head to seat on frame. Install the two frame screws.

(d) Attach field coil lead wires to brush holders as follows: black field lead to adjustable third brush holder, gray armature lead to stationary brush holder insulated from head. Use same washer and screw which attach brush leads to attach these wires.

(e) Slide cover band into position over brush access holes in frame, and tighten bolt into nut.

(f) Tap thrower into position on end of armature shaft. Tap key into keyway and press drive gear onto shaft and key. Install nut and cotter pin on end of drive shaft.

50. TWO-CHARGE REGULATOR.**a. Removal (fig. 72).**

(1) Disconnect "CG" wire from terminal on top side of regulator.

(2) Remove the four screws and lock washers which attach regulator to generator.

(3) Disconnect red field lead wire from "F" terminal, and gray armature lead wire from "A" terminal. These terminals are both on attaching side of regulator.

(4) Lift regulator from generator.

b. Disassembly (fig. 78).

(1) Remove cover nut and lift cover from regulator.

(2) Remove the two screws, lock washers, and flat washers which attach resistor to side of base. Lift resistor and two flat washers from base.

(3) Unscrew retainer and remove fuse and insulation from base.

(4) Unclip circuit breaker armature spring from hooks on armature and frame. Similarly remove voltage regulator spring.

c. Inspection and Repair.

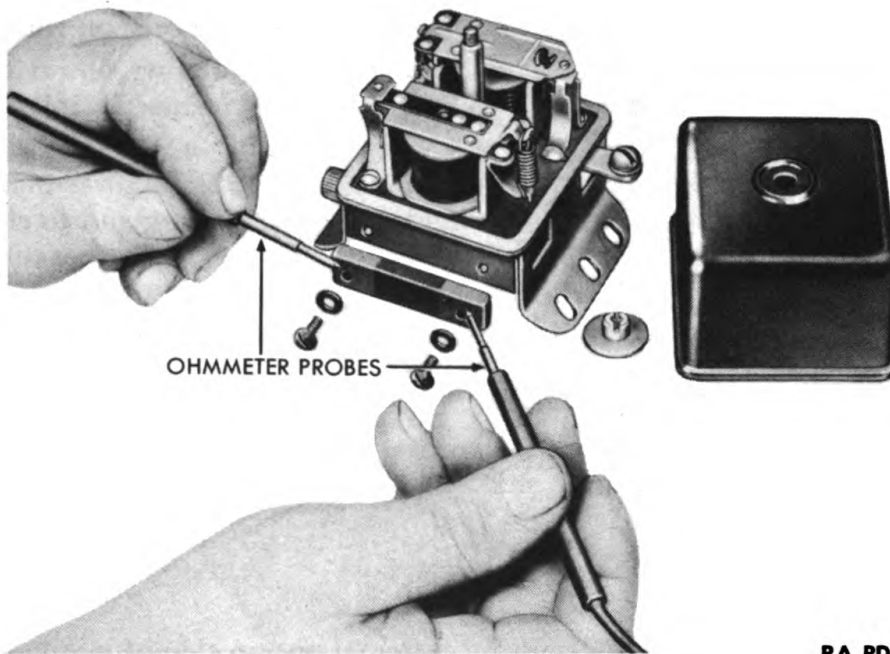
(1) Examine for evidence of burning or abnormally high temperatures at the coils, contacts, insulation, external terminals, or other points.

(2) Examine for loose connections resulting from poor soldering.

(3) Examine for loose nuts on bottom of magnet cores, loose rivets, or screws. All nuts and screws must have lock washers.

(4) **CONTACTS.** Clean all contacts by filing, parallel with length of the armature, with a very fine file so that they are free from pits and burning. Clean points with carbon tetrachloride to remove any

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78588

Figure 73—Testing Regulator Carbon Resistor

dirt or grease. Pull a piece of clean cloth between contacts to remove any residue.

(5) **CARBON RESISTOR** (fig. 73). Check resistance of the carbon resistor with an ohmmeter. It must read 11 ohms, plus or minus 5 percent.

(6) **CIRCUIT BREAKER ARMATURE AIR GAP**. Check circuit breaker armature air gap. This check is made with contacts closed, and is adjusted by raising or lowering stationary contact. Adjust to 0.010 to 0.030 inch.

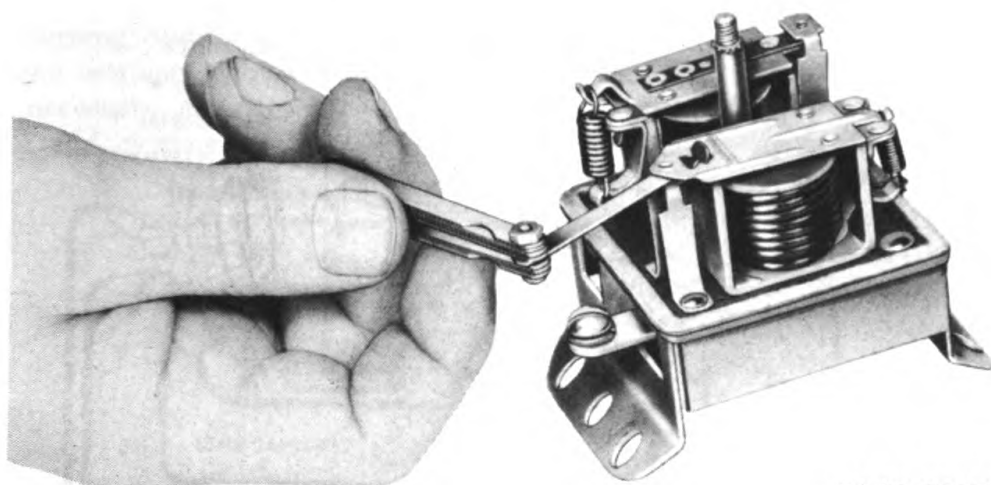
(7) **CIRCUIT BREAKER CONTACT GAP** (fig. 74). Check circuit breaker contact gap. It must be 0.015 to 0.045 inch. Adjust by bending armature stop.

(8) **REGULATOR ARMATURE AIR GAP** (fig. 75). Check regulator armature air gap. It must be 0.044 to 0.046 inch. Measure gap with regulator contact closed. Adjust by raising or lowering upper contact by expanding or contracting the bridge holding upper contact.

(9) **CHECK REGULATOR CONTACT GAP**. Check regulator contact gap; it must have 0.005-inch minimum gap. Adjust by bending brass cam.

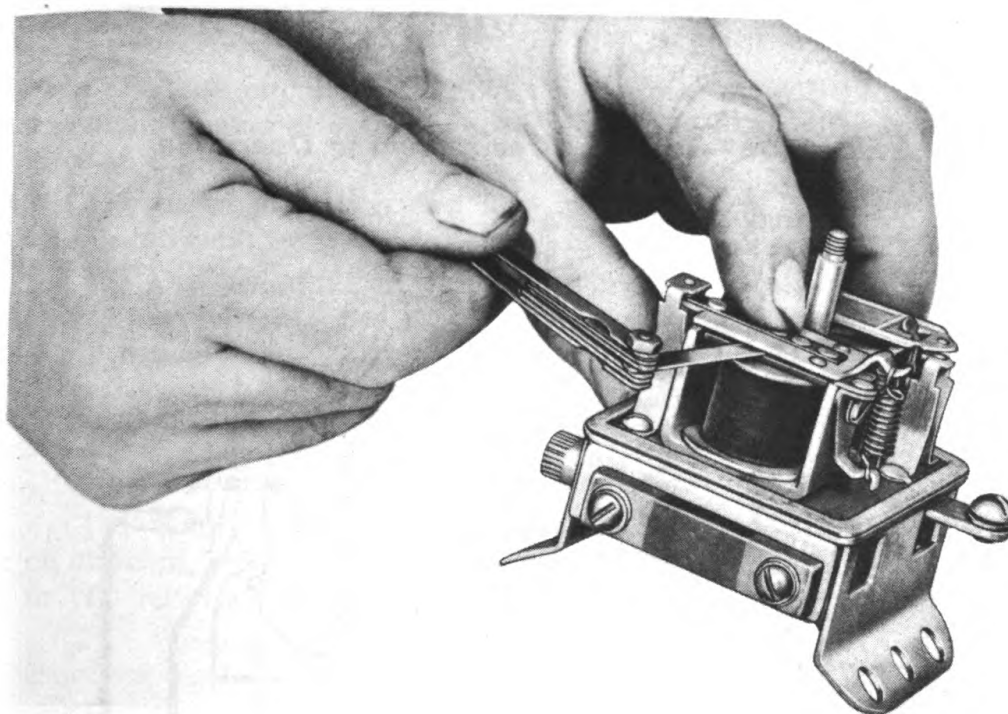
(10) **TEST AND ADJUST CIRCUIT BREAKER OPERATION**. Connect a voltmeter as shown in figure 86. Increase the voltage from zero and note voltage at which points close as indicated by lamp lighting. Points should close between 13.0 and 13.5 volts. Adjust, if necessary,

ENGINE AND ACCESSORIES



RA PD 78595

Figure 74—Checking Circuit Breaker Contact Gap



RA PD 78582

Figure 75—Checking Regulator Armature Gap

by increasing or decreasing tension of circuit breaker armature spring. This is done by bending hanger at bottom of spring.

(11) **TEST AND ADJUST REGULATOR OPERATION.** Connect a voltmeter as shown in figure 77. Increase the voltage from zero and

ORDNANCE MAINTENANCE—GENERATING UNIT M18

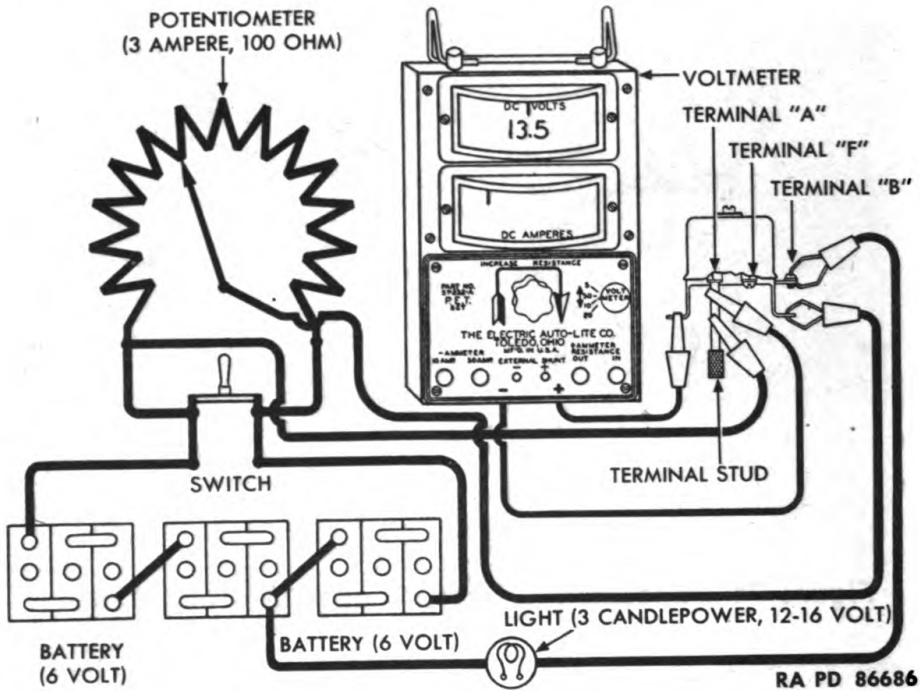


Figure 76—Testing Circuit Breaker Operation

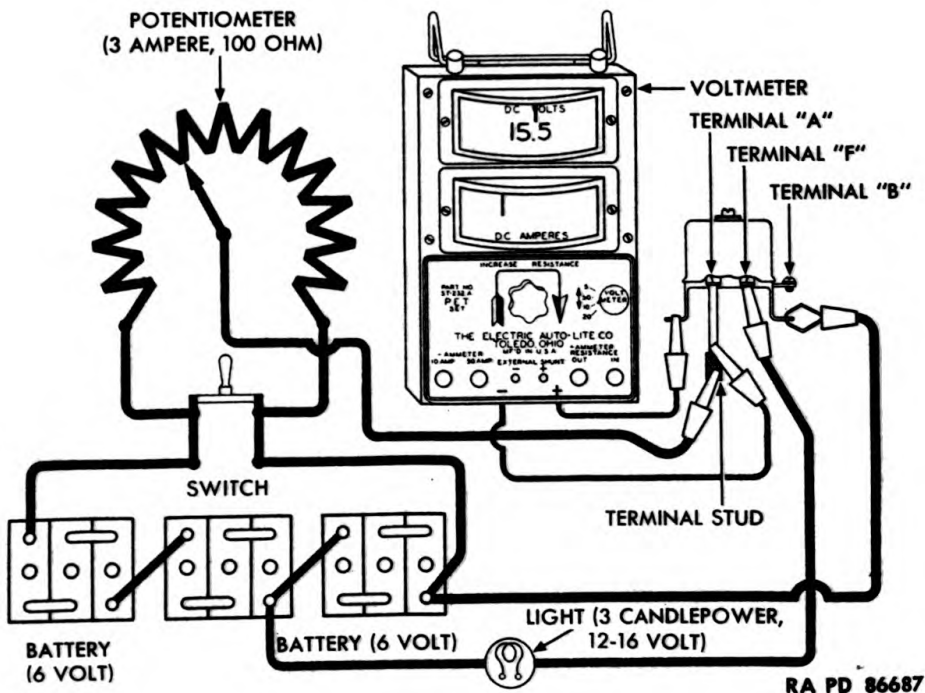


Figure 77—Testing Regulator Operation

ENGINE AND ACCESSORIES

notice voltage at which contacts open. This is indicated by the lamps becoming dim or going out. Reduce the voltage and note reading when contacts open as indicated by brightening or lighting of lamp. If necessary, alter tension of regulator armature spring to bring opening and closing voltages within range indicated by following table:

Temperature (Degrees Fahrenheit)	High-to-low Charge (Volts)
50	15.95 \pm 0.20
60	15.80 \pm 0.20
70	15.65 \pm 0.20
80	15.50 \pm 0.20
90	15.35 \pm 0.20
100	15.20 \pm 0.20
110	15.05 \pm 0.20

NOTE: *When generator changes from low charge rate to high charge rate, the voltage is 2.0 to 2.4 volts lower than when it changes from high charge rate to low charge rate.*

d. Assembly (fig. 78).

(1) Hook circuit breaker armature spring AL-CB-123 to hooks on circuit breaker armature and frame. Similarly install voltage regulator spring AL-IG-863 on voltage regulator.

(2) Insert insulation and fuse into socket in base of regulator and install retainer.

(3) On base of regulator, position two fibre washers, one resistor, two flat washers, and two lock washers. Install the two screws which attach these parts.

(4) Position cover on regulator and install cover nut.

e. Installation (fig. 72).

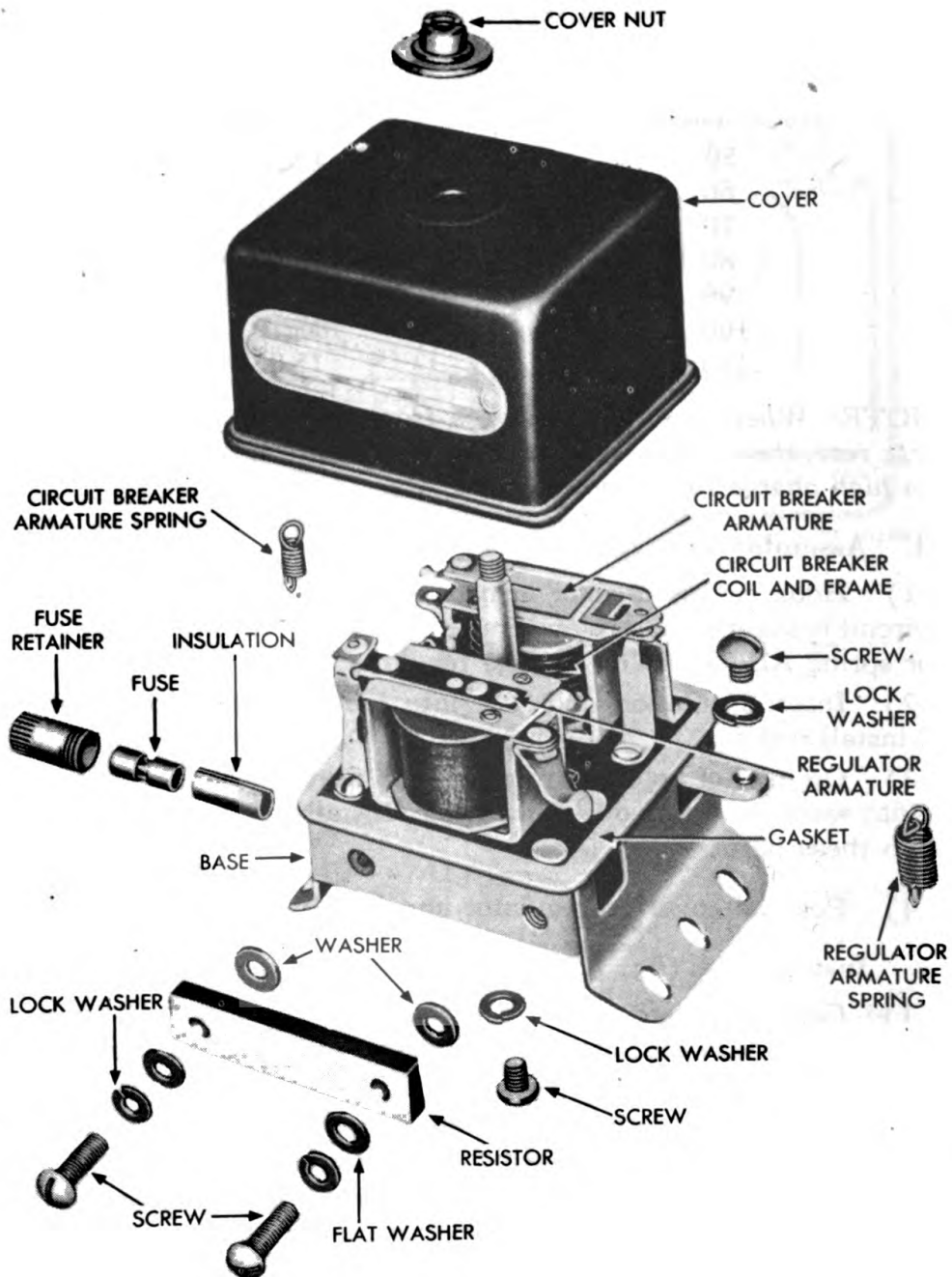
(1) Connect generator armature lead wire (gray) to "A" terminal on attaching side of regulator. Connect generator field lead wire (red) to "F" terminal.

(2) Position regulator on generator (fuse down) and install the four lock washers and screws which hold regulator to generator.

(3) Connect "CG" wire to terminal on top of regulator.

51. ELECTRIC BRAKE RECEPTACLE.

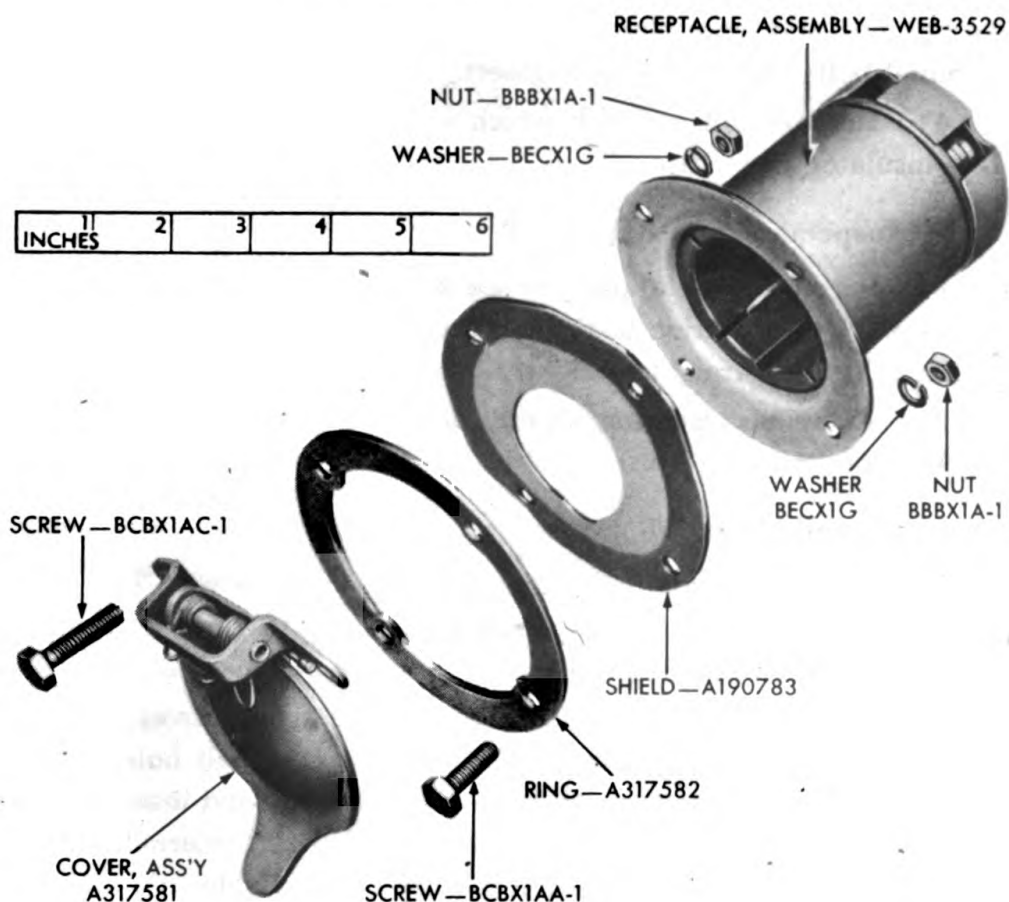
a. General. The electric brake receptacle consists of a four-blade receptacle with a spring-loaded cover. The receptacle is of metal construction and is cylindrical in shape. It is attached perpendicularly to the rear side of the left rear panel by four screws. It encases an insert which holds the four blades in equally spaced grooves.



RA PD 78620

Figure 78—Two-charge Regulator Partially Disassembled

ENGINE AND ACCESSORIES



RA PD 78220

Figure 79—Electric Brake Receptacle Disassembled

Attached to the front side of panel, the cover assembly seals the receptacle when not in use.

b. Removal (fig. 1). Disconnect wire "63" from "TL" terminal on rear of receptacle. Remove the four nuts, lock washers, and screws which attach electric brake receptacle and electric brake cover assembly to panel. Lift cover and ring from front of panel, and socket and shield from rear of panel.

c. Disassembly (fig. 79).

(1) Punch out rivet which holds spring and cover to bracket. Separate the spring and cover from bracket.

(2) Remove nut and lock washer from bolt which attaches cap to rear of case. Lift cap from case.

(3) From each of the four terminal bolts on rear of case, remove two nuts, special washer A190691, plain washer, internal toothed lock

ORDNANCE MAINTENANCE—GENERATING UNIT M18

washer, nut, and large plain washers. Pull insert from case and slide terminal bolts and blades from insert.

(4) Remove nut and bolt which attach insulator to rear of case. Lift insulator from case.

d. Inspection and Repair.

(1) Inspect all metal parts to see if they are bent, broken, burred, or worn. Note condition of threads on threaded parts. Remove burs with a mill file. Straighten slightly bent parts if possible.

(2) Examine insulator, insert, and shield to see if they are cracked, broken, or torn.

e. Assembly (fig. 79).

(1) Place insulator in position on back of case with bolt holes alined. Through center hole, insert bolt A325612 from inside case. Install nut on bolt.

(2) Position the four blades in their respective grooves on inside of insert. Slide insert into case and aline terminal bolt holes. Insert the four terminal bolts through blades, insert, case, and insulator. On each terminal bolt, install large plain washer, nut, internal toothed lock washer, plain washer, special washer (dished side in), and two nuts.

(3) Slide cap onto bolt projecting from center of rear of case. Turn cap so large slot is adjacent to terminal bolt marked "TL." Install internal toothed lock washer and nut which attaches cap to case.

(4) Place cover spring in position on cover and place bracket in position on spring and cover. Aline rivet holes of cover, spring, and bracket and slide rivet into position. Crimp over end of rivet.

f. Installation (fig. 1).

(1) Place ring and cover assembly in position on front side of side panel. Insert the two long screws through cover bracket, ring, and panel. Insert the two short screws through ring and panel.

(2) On rear side of panel, slide shield and receptacle into position on the four screws. Install lock washer and nut on each screw.

(3) Connect wire "63" from small terminal block to "TL" terminal bolt on rear of receptacle.

ENGINE AND ACCESSORIES**Section VII****ENGINE ELECTRICAL SYSTEM—IGNITION****52. DESCRIPTION.**

a. **General** (fig. 80). Components of the ignition system are ignition coil, distributor (with condenser), spark plugs, and necessary wires. Its function is to provide electric sparks across the spark plug electrodes, to cause engine combustion.

b. **Ignition Coil** (fig. 80). This is a self-contained unit. It consists of an iron core around which are wound a relatively few turns of heavy wire connected in the primary circuit, and many turns of fine wire connected in the secondary circuit. Core and coils are enclosed in a sealed case to form the complete coil. Its function is to step up the low-voltage current in the primary circuit to high-voltage current in the secondary circuit. This high voltage is needed to produce a spark across the electrodes of the spark plugs by which the explosive mixture in the cylinders is ignited.

c. **Distributor** (figs. 80 and 81). Principal parts of the distributor are housing (consisting of base and cap), breaker points, shaft and governor, cam, rotor, and condenser. The shaft extends through the length of the body and is geared to the distributor drive gear on the water pump drive shaft. Centrifugal force acts on weights hinged to the shaft. Increased speed throws weights outward and, by means of weight pins through cam, causes the cam to twist slightly. This advances the spark. The shaft also carries the cam and rotor which revolve with it. The cam actuates the breaker points. The function of the breaker points is to open and close the ignition coil primary circuit at the proper times. This causes the field of magnetism in the coil's core to alternately collapse and revive. The collapse, "boosted" by condenser action, causes a surge of high-voltage current in the secondary winding. This high-voltage current travels from the coil to the distributor rotor which discharges it to the proper spark plug. The condenser, located within the distributor, serves to check the flow of current across the distributor points the moment they open. This permits more rapid energization of the secondary windings of the coil, and at the same time prevents burning the distributor breaker points.

d. **Spark Plugs** (fig. 80). Each of the six spark plugs consists of a metal shell encircling an insulator with a central electrode stem. Another electrode is attached to the lower end of the shell. These two electrodes are separated by an 0.025-inch air gap. The top end of the central electrode stem is finished as a terminal to which the wire from the distributor cap attaches. The metal shell is threaded

ORDNANCE MAINTENANCE—GENERATING UNIT M18

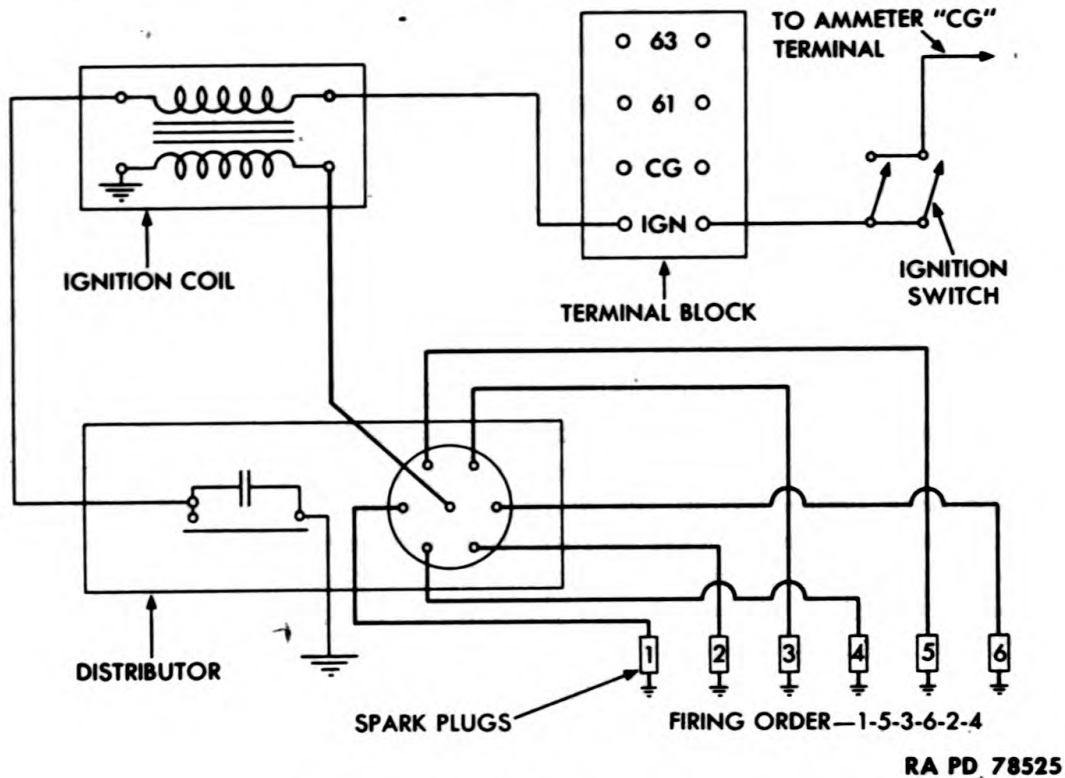


Figure 80—Ignition System Diagram

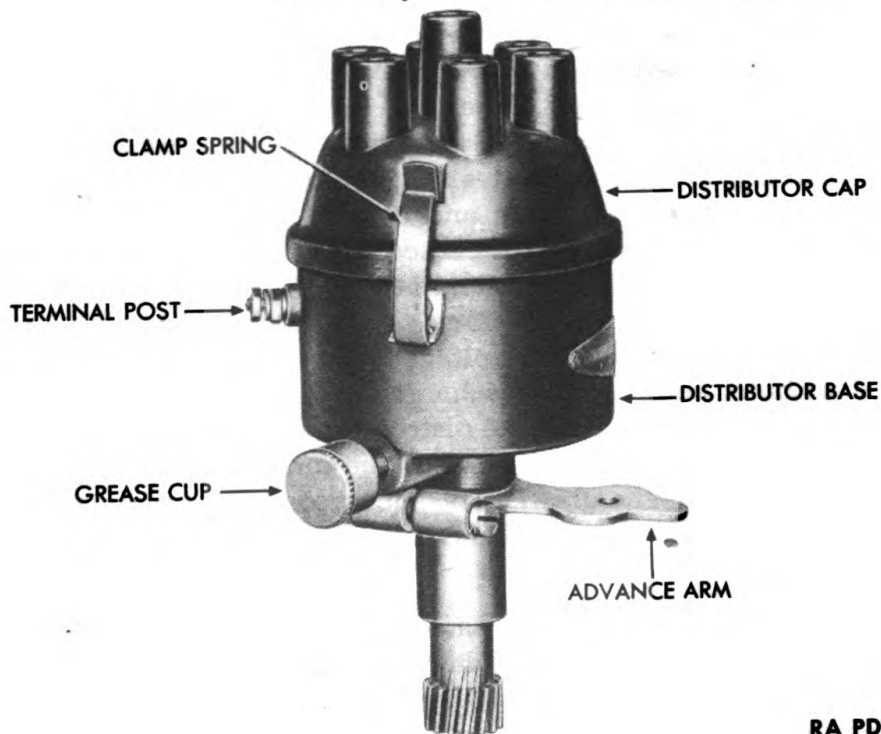
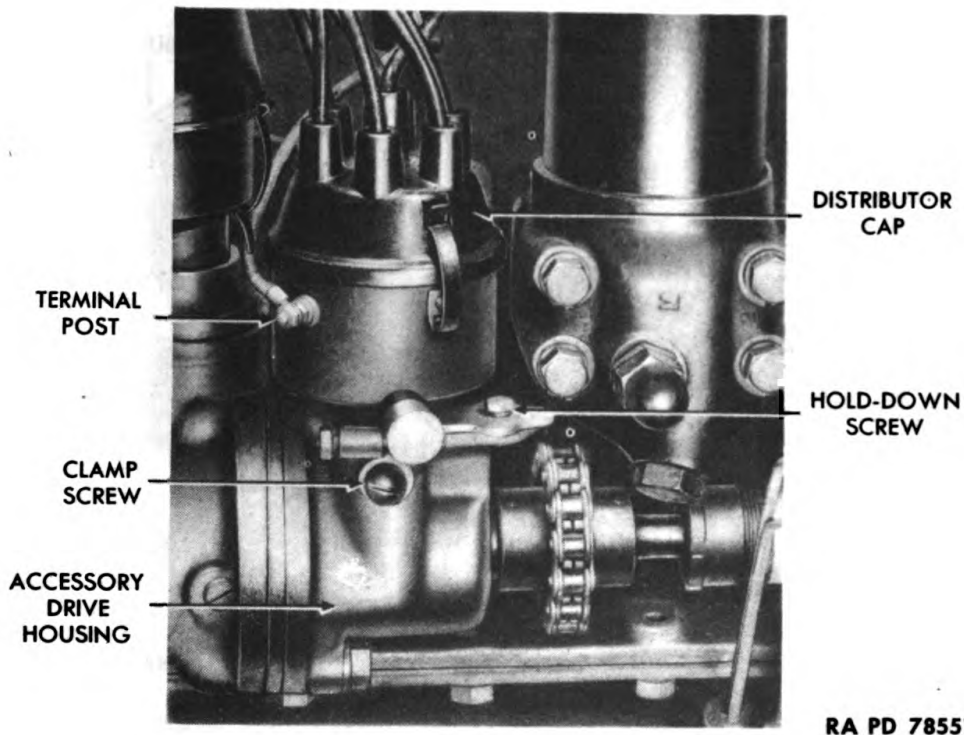


Figure 81—Distributor

ENGINE AND ACCESSORIES



RA PD 78551

Figure 82—Distributor Installed

to permit screwing into the cylinder head. In operation, the high-voltage current from the distributor arcs across the electrodes to create a spark at the proper instant to ignite the mixture within the cylinder.

53. IGNITION COIL.

a. **Test.** Remove coil and place in a coil tester. Check spark gap while running free and under load. If spark jumps a $\frac{1}{4}$ -inch gap under load, coil is in satisfactory condition. *NOTE: In absence of coil testing equipment, compare performance with another 12-volt coil known to be good. Replace coil if performance does not equal that of test coil.*

54. DISTRIBUTOR.

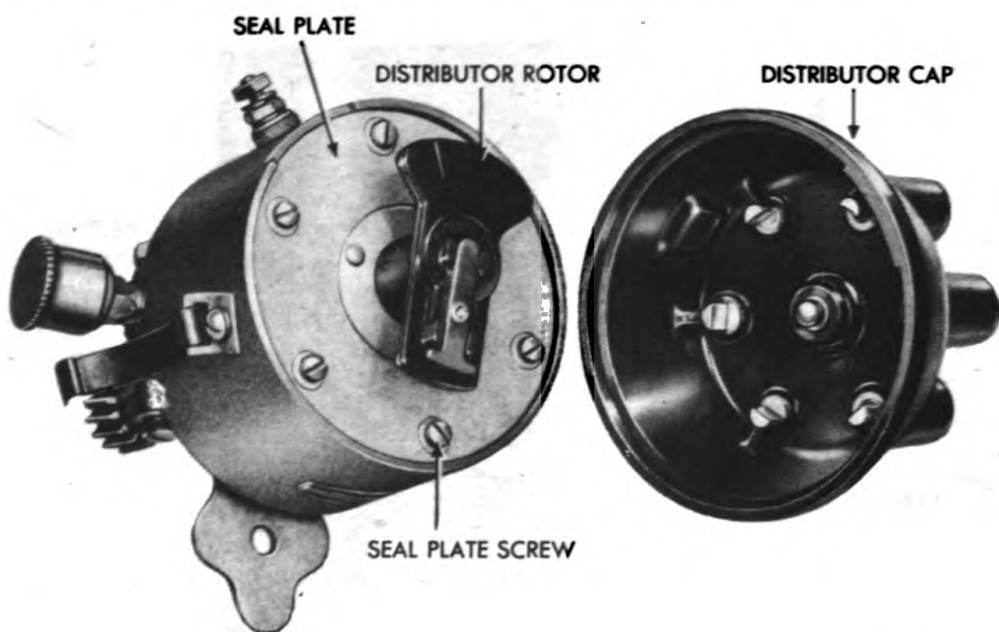
a. Removal (fig. 82).

(1) Pull high-tension wires from cap and disconnect primary lead wire from terminal post on side of distributor.

(2) Remove hold-down screw and lock washer. Loosen clamp screw in water pump drive (accessory drive) housing.

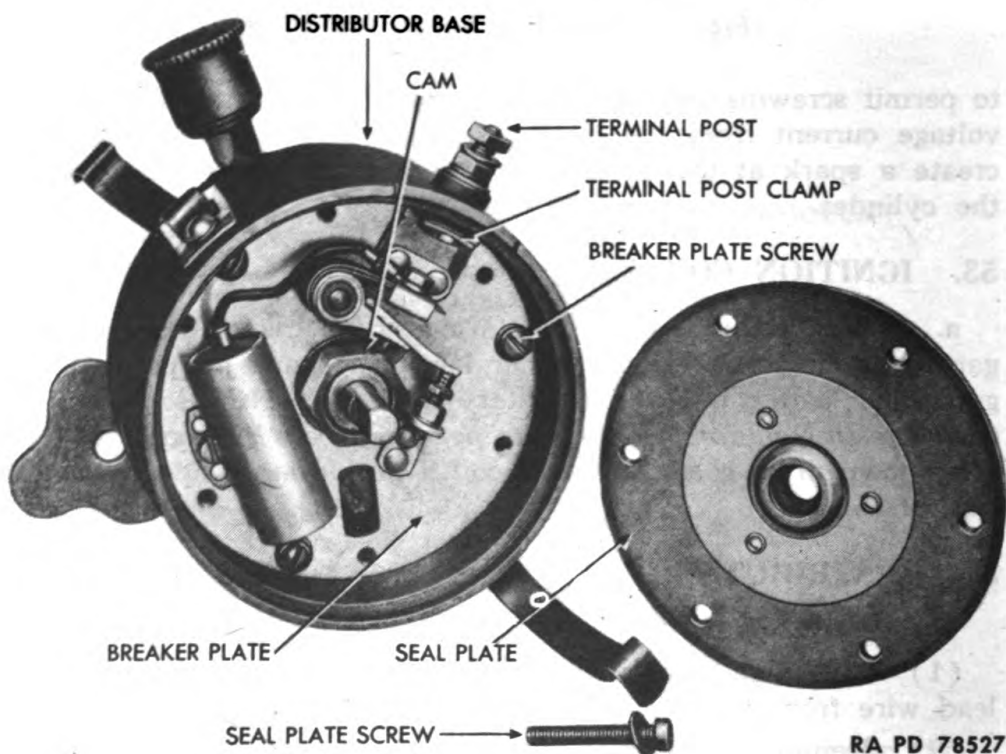
(3) Lift distributor from water pump drive housing.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78511

Figure 83—Distributor—Cap Removed



RA PD 78527

Figure 84—Distributor—Seal Plate Removed

ENGINE AND ACCESSORIES

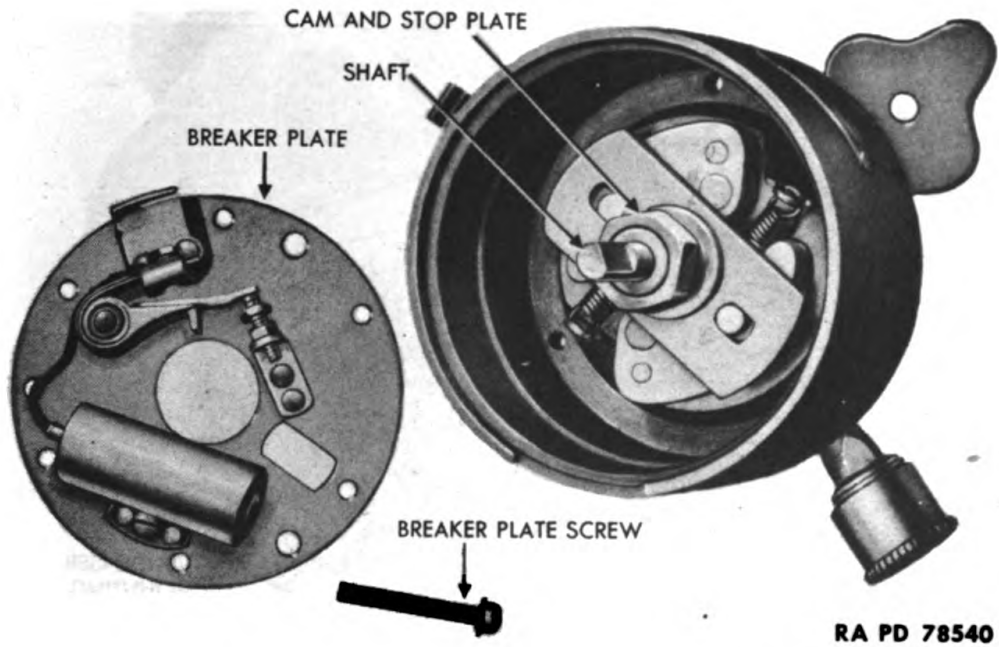


Figure 85—Distributor—Breaker Plate Removed

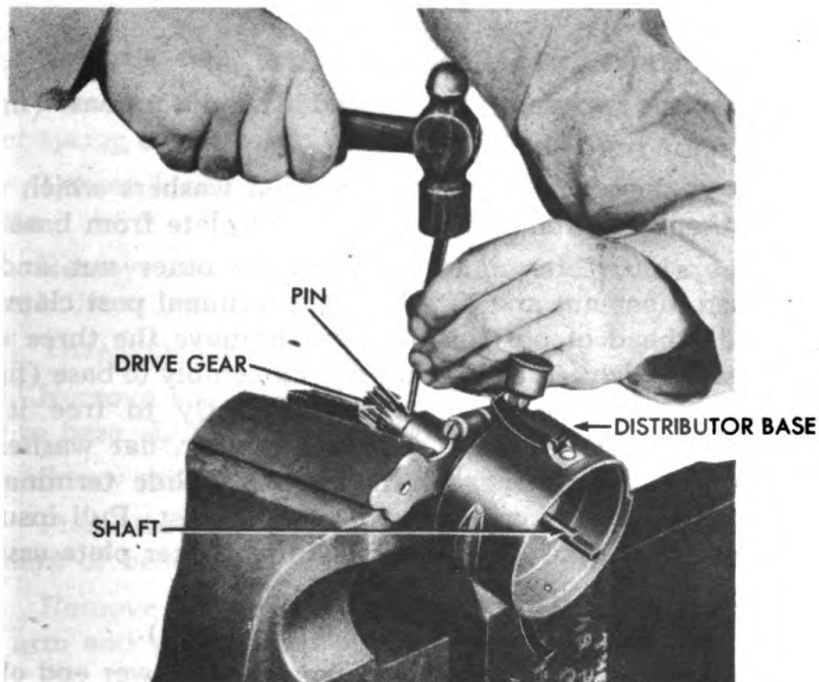


Figure 86—Removing Distributor Gear From Shaft

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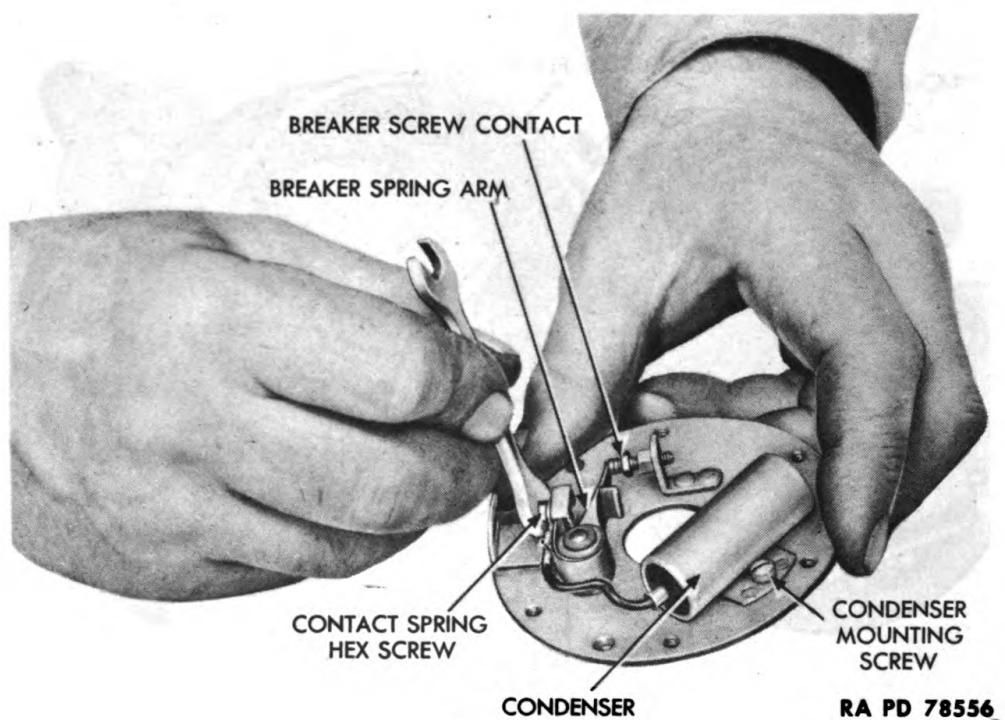


Figure 87—Disassembling Breaker Plate Assembly

b. Disassembly.

(1) DISASSEMBLE INTO SUBASSEMBLIES.

- (a) Unhook the two clamp springs and lift cap from base (fig. 81).
- (b) Pull rotor from shaft (fig. 62).
- (c) Remove the six seal plate screws and washers which attach seal plate to breaker plate (fig. 83). Lift seal plate from base.
- (d) From primary terminal post, remove outer nut and lock washer. Loosen inner nut and lift U-shaped terminal post clamp (fig. 84) from under head of post inside base. Remove the three screws and lock washers which attach breaker plate assembly to base (fig. 84). Twist breaker plate counterclockwise sufficiently to free it from primary terminal post. Remove nut, lock washer, flat washer, and insulating washer from primary terminal post. Slide terminal post from inside base and lift inside insulation from post. Pull insulating bushing from terminal post hole in base. Lift breaker plate assembly from base.
- (e) Lift cam and stop plate from shaft (fig. 85).
- (f) Drive out pin which attaches drive gear to lower end of shaft (fig. 86). Press gear from shaft. Lift washer from shaft and pull shaft and governor assembly from top of base. Slide curved washer from shaft.

ENGINE AND ACCESSORIES

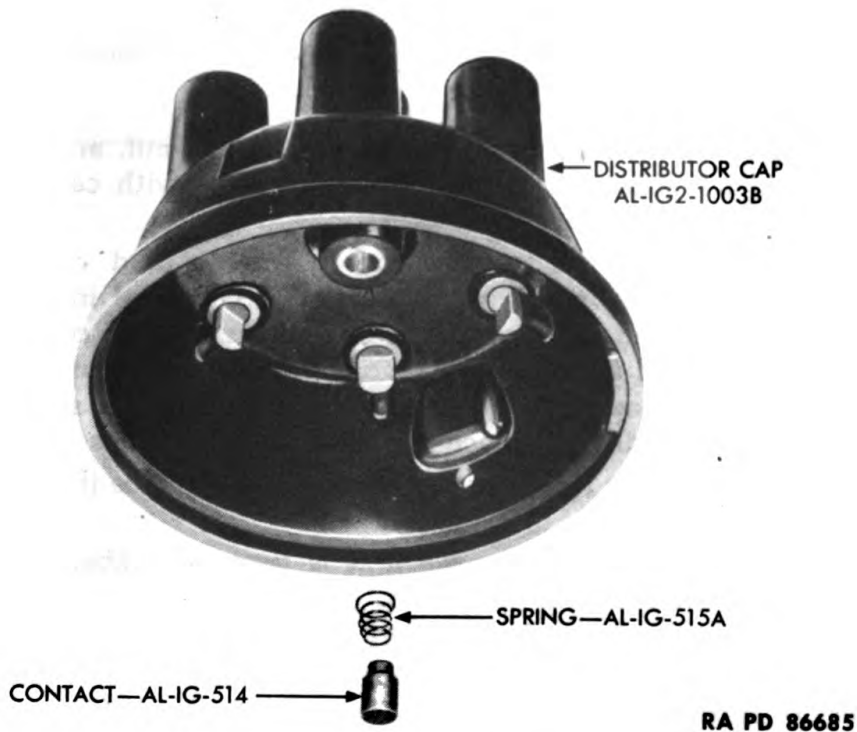


Figure 88—Distributor Cap Disassembled

- (2) **DISASSEMBLE BREAKER PLATE** (fig. 87).
 - (a) Remove contact spring hexagonal screw and washer and lift breaker spring arm assembly from post on plate.
 - (b) Loosen lock nut and screw breaker screw contact from angle on plate.
 - (c) Remove condenser mounting screw and lock washer and lift condenser from breaker plate.
- (3) **DISASSEMBLE BASE** (fig. 81).
 - (a) Remove screw and lock washer which attaches each spring clamp to base. Lift clamps from base.
 - (b) Screw grease cup from base.
 - (c) Press the two absorbent bronze bearings from base if replacement of bearings is found necessary (subpar. c (8), below).
 - (d) Remove nut, washer, and bolt from advance arm. Slide advance arm and washer from underside of base.
- (4) **DISASSEMBLE SHAFT AND GOVERNOR.**
 - (a) Pull weight springs from pins on weights and weight plate.
 - (b) Lift weights from pivots.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(5) **DISASSEMBLE CAM AND STOP PLATE.** Pull anti-rattle spring from stop plate.

c. Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, and dry with compressed air. Clean distributor cap and rotor with carbon tetrachloride and dry with a clean cloth.

(2) Inspect cap for cracks, carbon streaks and corroded or burned inserts. Note condition of plunger at center of inside of cap to see if it is broken or badly burned. Depress plunger contact with the finger to see if it binds or if spring fails to return it to normal position. Replace cap if it is cracked, if the carbon is streaked, or if inserts are corroded. Replace cap and rotor if inserts are burned.

(3) Inspect rotor for cracks or burned tip. Replace if either condition is present.

(4) Inspect seal plate to see if it is bent or if fiber or rubber seals are worn, torn, or deteriorated.

(5) Check condenser on an M1 Circuit Tester. Connect bare clip of low-tension lead to a ground on an engine. Connect red clip to battery or starting switch terminal. Insert condenser in clip on tester, and attach short test lead to condenser pig tail. Place coil test switch at "test coil." Turn on rotor switch, and adjust variable spark gap to highest setting obtainable without missing. Move condenser test switch to "vehicle cord," and observe effect on high-tension output and on arcing at tester breaker contacts. Repeat test several times, changing position of condenser pig tail lead. If switching to "vehicle cord" does not result in arcing and spark does not miss, and if changing position of condenser pig tail does not effect action, condenser is in satisfactory condition. Replace condenser if it fails on any one or more of the above tests.

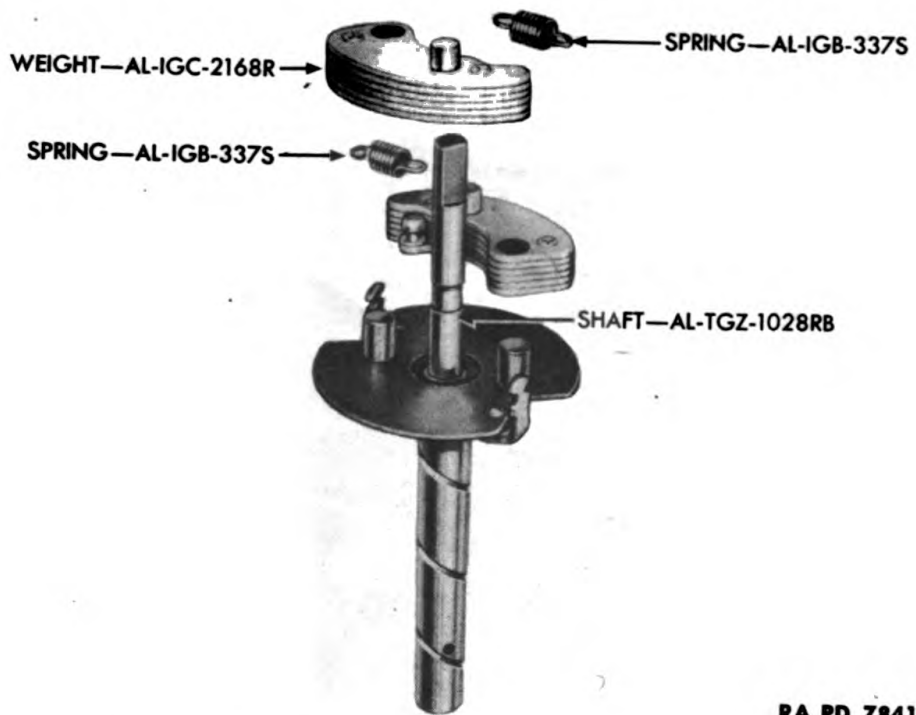
(6) **INSPECT BREAKER CONTACTS.** If they are grayish color and not more than slightly pitted, they can be used again. Test fit of breaker arm on pivot to see if it binds or has excessive side play. Clean up slightly pitted contacts with a stone. Do not file. Replace discolored, badly pitted, or worn contacts. Replace breaker arm if it binds or fits loosely on pivot.

(7) Inspect governor weights, plate, and shaft for wear or scoring. Inspect springs for distortion. Pack pockets in laminated weights with seasonal grade, general purpose grease (No. 0). Reassemble governor, making sure weight springs have small loops on weight pins.

(8) Inspect base to see if it is broken. Inspect bearings to see if they are scored. Test fit of bearings on shaft.

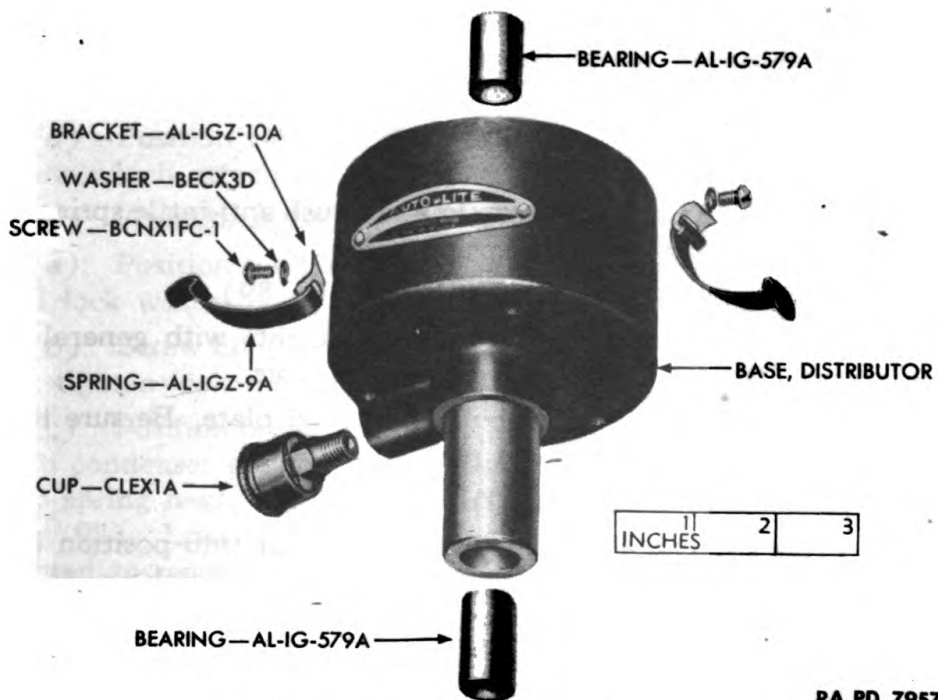
(9) Inspect cam, breaker plate, gear, pin, clamp springs, anti-rattle spring, grease cup, advance arm, screws, nuts, and washers to see

ENGINE AND ACCESSORIES



RA PD 78414

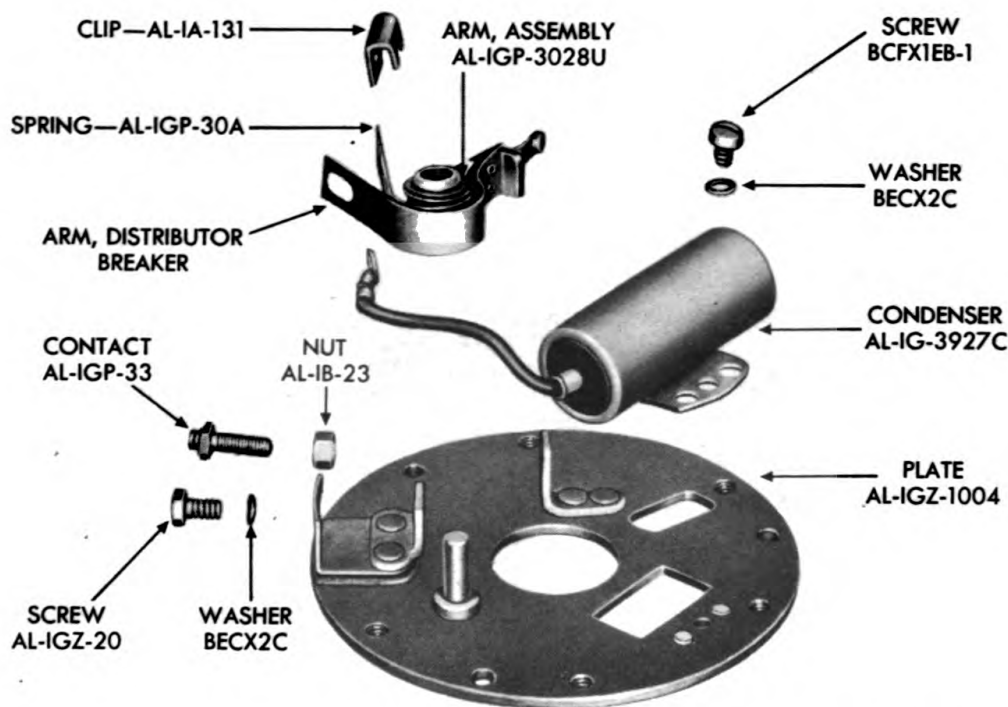
Figure 89—Distributor Shaft Disassembled



RA PD 79574

Figure 90—Distributor Base Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78417

Figure 91—Distributor Breaker Plate Disassembled

if any are bent, broken, scored, worn, or burred. Note condition of threads on threaded parts. Remove burrs with a file. Replace distributor assembly, if unrepairable.

d. Assembly.

(1) **ASSEMBLE CAM AND STOP PLATE.** Push anti-rattle spring onto shaft and insert bent end into spring hole.

(2) **ASSEMBLE SHAFT AND GOVERNOR** (fig. 89).

(a) Fill grease pockets in laminated weights with general purpose grease (No. 0). Position weights on pivots.

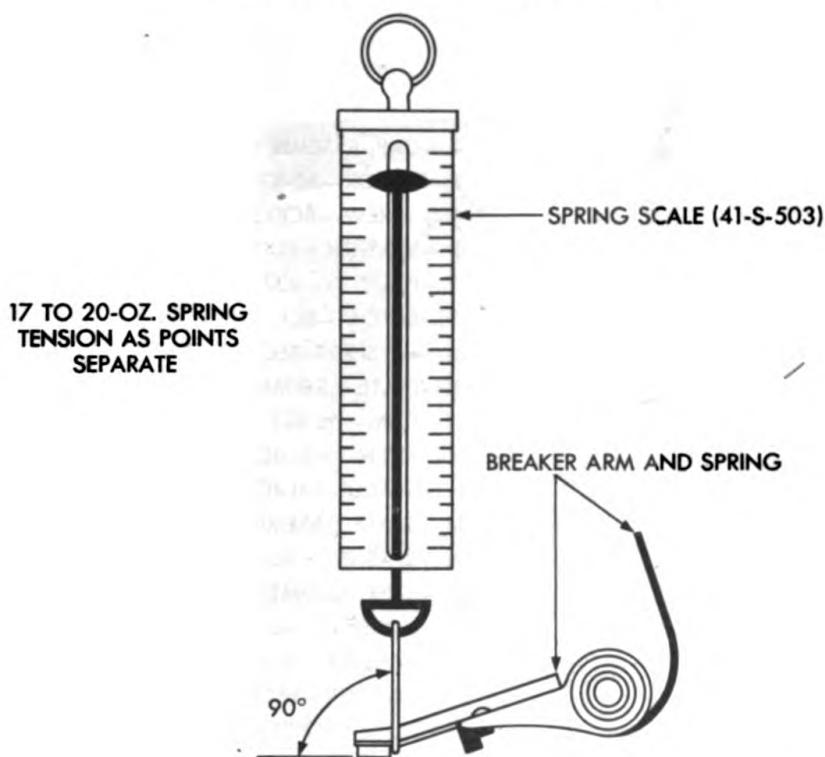
(b) Install springs on pins, on weights and plate. Be sure to put small spring loops on the weight pins.

(3) **ASSEMBLE BASE** (fig. 90).

(a) Press the two absorbent bronze bearings into position inside base. Make lower bearing flush with base. Countersink upper bearing. Spread a film of general purpose grease on bearings as prescribed in TM 9-617.

(b) Position advance arm on base with screw hole centered under manufacturer's name plate on base. Install the bolt, washer, and nut which clamp advance arm to base.

ENGINE AND ACCESSORIES



RA PD 79553

Figure 92—Measuring Breaker Point Spring Tension

(c) Fill grease cup with seasonal grade, general purpose grease and screw into place in base.

(d) Position clamp springs on base and install lock washer and screw which attach each clamp.

(4) ASSEMBLE BREAKER PLATE (fig. 91).

(a) Position condenser on base. Install condenser mounting screw and lock washer.

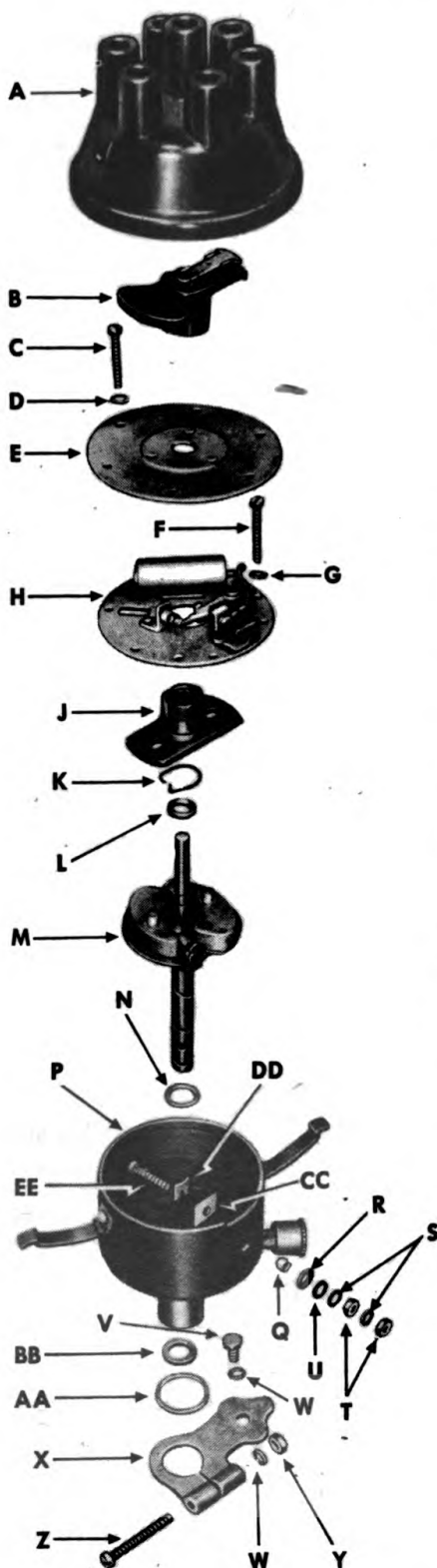
(b) Screw breaker screw contact into approximate position but do not tighten lock nut.

(c) Position breaker spring arm on pivot. Place spring in position with condenser pig tail lug over screw hole. Install washer and contact spring hexagonal screw. Test spring tension with a spring scale (fig. 92). Loosen contact spring hexagonal screw and loosen or tighten to secure 17 to 20 ounces tension.

(5) ASSEMBLE SUBASSEMBLIES (fig. 93).

(a) Slide washer onto lower end of shaft and position governor and shaft within base. Slide washer onto protruding shaft. Align pin-holes in gear and shaft and press gear onto shaft. Drive pin through gear and shaft. Peen pin.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

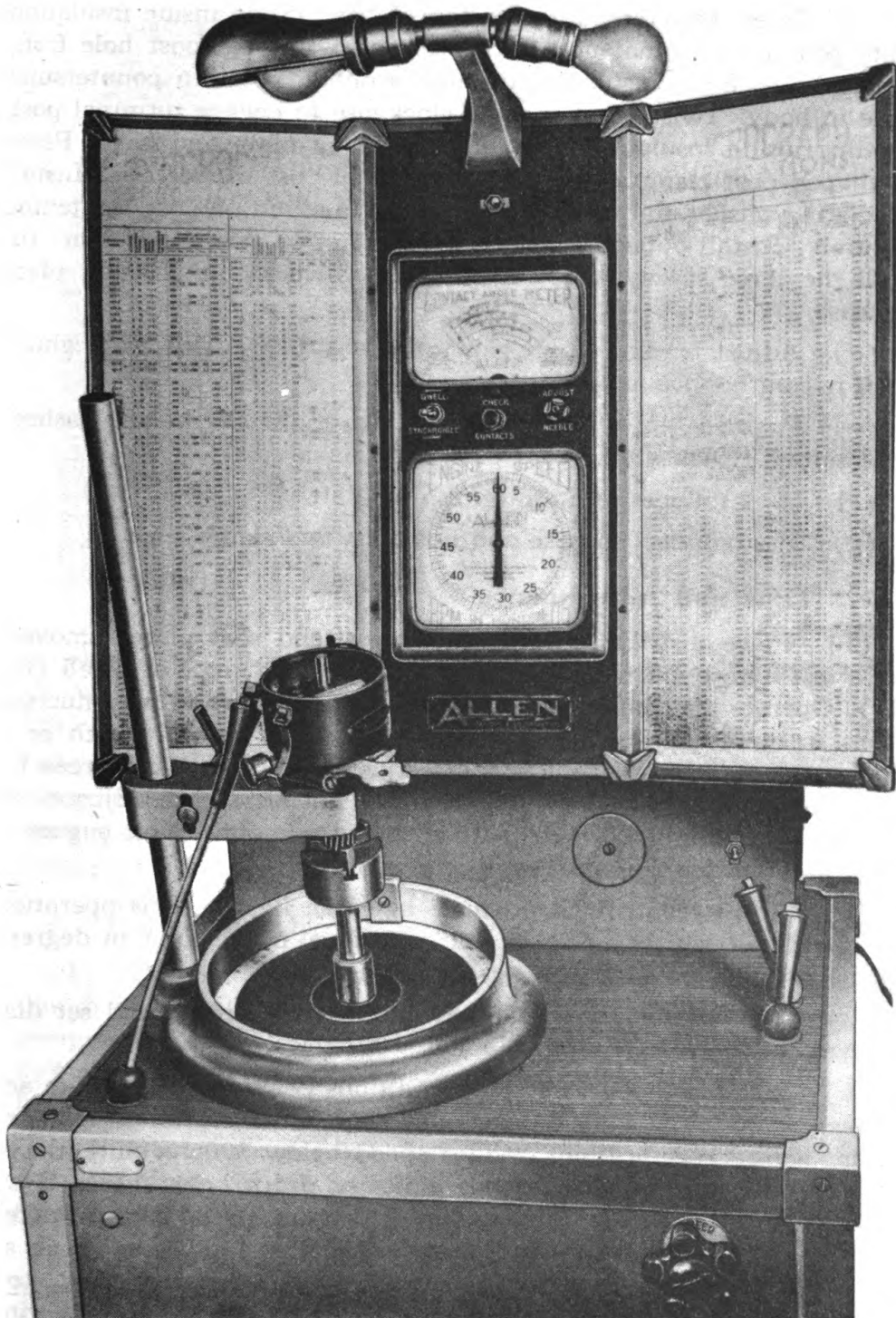


- A—CAP, ASSEMBLY—AL-IGZ-1003B
- B—ROTOR—AL-IGZ-1016
- C—SCREW—BCFX2AM-1
- D—WASHER—AL-8X-350
- E—PLATE—AL-IGZ-1005
- F—SCREW—BCFX2AN-1
- G—WASHER—BECX3D
- H—PLATE, ASSEMBLY—AL-IGZ-2004A
- J—CAM—AL-IGZ-1021RH
- K—SPRING—AL-IGE-35
- L—SPACER—AL-IGS-99
- M—SHAFT, ASSEMBLY—AL-IGZ-2028R
- N—WASHER—AL-IGS-104
- P—BASE, ASSEMBLY—AL-IGZ-2011A
- Q—BUSHING—AL-IGL-10
- R—WASHER—AL-IGL-9
- S—WASHER—BECX1E
- T—NUT—BBKX2CA-1
- U—WASHER—AL-8X-183B
- V—SCREW—BCAX3K-1
- W—WASHER—BECX3G
- X—ARM—AL-IGC-2024AQ
- Y—NUT—BBJX1A-1
- Z—SCREW—BCFX2DR-1
- AA—WASHER—AL-IG-816E
- BB—WASHER—AL-IG-90
- CC—INSULATION—AL-IGZ-15
- DD—CLAMP—AL-IGZ-18
- EE—POST—AL-IGL-8A

RA PD 78416

Figure 93—Distributor Disassembled

ENGINE AND ACCESSORIES



RA PD 79564

Figure 94—Distributor in Test Fixture

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(b) Slide cam and stop plate onto top end of shaft, guiding weight pins into openings in stop plate.

(c) Insert breaker plate into top of base. Slide inside insulation onto primary terminal post and insert post through post hole from inside base. Slide insulating bushing around post into countersunk hole in body. Twist breaker plate clockwise to engage terminal post, guiding inside insulation between contact on plate and base. Place U-shaped post clamp over head of terminal post inside base. Install insulating washer, flat washer, lock washer, and nut on post, tightening securely. Install outside lock washer and nut on post fingertight. Install the three screws and lock washers which secure breaker plate to base.

(d) Adjust breaker point gap to 0.020 ± 0.002 inch and tighten lock nut on breaker screw contact.

(e) Position seal plate over top of base. Install the six washers and screws which attach seal plate to breaker plate.

(f) Push rotor in position on top of shaft.

(g) Position cap on base and hook the two clamp springs.

e. Tests and Adjustments.

(1) Place distributor, with cap, rotor, and seal plate removed, on a test fixture and set controls to measure cam angle or dwell (fig. 94). Operate distributor up and down speed range and note fluctuations in meter. Excessive fluctuation is caused by worn cam or a sticking contact arm on its pivot. Adjust reading to 41 degrees by changing contact point gap. Tighten lock nut after each adjustment. This operation can be done with distributor mounted on engine if only M1 Ignition Circuit Tester is available.

(2) Adjust centrifugal advance as given below. This operation can be done only in a fixture that will show firing point in degrees and distributor speed in revolutions per minute.

(a) Run distributor at 250 revolutions per minute and set dial at zero degree.

(b) Increase speed to 1,150 revolutions per minute and note advance. Specifications are 6 distributor degrees. If maximum advance is not within specifications, reduce speed below 300 revolutions per minute and note whether or not indicator drops below zero. If an indication below zero is shown, stop distributor. Bend lugs on outer spring bracket slightly toward center (fig. 95) and again check at 1,150 revolutions per minute. If advance is still not 6 degrees, stop distributor and relieve spring tension slightly by bending outer spring brackets (fig. 95). Advance specifications for distributor at various speeds are as follows:

ENGINE AND ACCESSORIES



RA PD 78524

Figure 95—Distributor Centrifugal Advance Adjustment

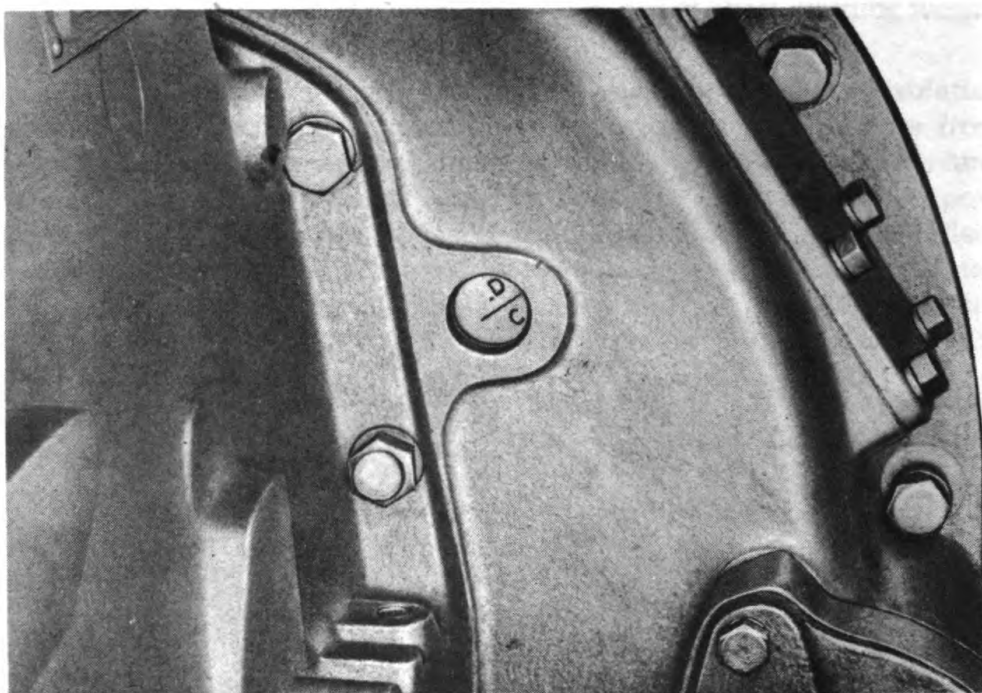
300 rpm	0 deg
450 rpm	1 deg
725 rpm	3 deg
1000 rpm	5 deg
1150 rpm	6 deg

f. Installation (fig. 82).

(1) Remove No. 1 (front) spark plug. Close plug hole with thumb and slowly hand-crank engine. Pressure on thumb indicates compression stroke. Continue cranking slowly until "DC" mark on flywheel is centered in peephole on front left side of flywheel bell housing. "DC" mark is accentuated by white paint.

(2) Remove cap from distributor. Turn rotor so it points to position of one of the inserts in cap. Distributor is then in No. 1 firing position.

(3) Place distributor down into position in water pump drive housing. Watch rotor as distributor gear engages gear on water pump drive. If rotor turns, withdraw distributor and reset rotor in No. 1 firing position, allowing for turn when gears mesh. Again position distributor in water pump drive housing.



RA PD 78575

Figure 96—Flywheel Timing Marks

(4) Install hold-down screw and lock washer. Tighten clamp screw on water pump drive.

(5) Connect primary lead wire to terminal post on side of distributor base.

(6) Install cap on base and insert high-tension secondary lead wire from coil into center tower of cap.

(7) Push wire from No. 1 spark plug into tower on cap to which rotor was pointed in step (2), above. Continue around cap, clockwise, installing wires from cylinders 5, 3, 6, 2, and 4, respectively.

(8) Time distributor (subpar. g, below).

g. Time Distributor.

(1) Attach one wire of a neon timing light to top terminal of No. 1 spark plug, and connect the other wire to ground. Start engine and run at idling speed.

(2) Point timing light through peephole in front left side of bell housing at timing marks on flywheel (fig. 96).

(3) If "DC" mark appears to be centered in peephole, timing is correct (fig. 96). Otherwise, loosen distributor clamp screw and advance arm clamp screw. Slowly rotate distributor to right or left until "DC" mark is centered. Tighten screws.

ENGINE AND ACCESSORIES**55. SPARK PLUGS.****a. 100-hour Inspection and Repair.**

(1) Examine manufacturer's symbol on porcelain. It should be Champion No. 1 "COMM," or equivalent. This is a cold plug. Under no circumstances should a hot type be used. Replace plugs if of wrong type.

(2) Inspect electrodes and replace plugs if electrodes are burned.

(3) Examine porcelains. Replace plugs having cracked or broken porcelains. Note color of porcelains and interpret as follows:

Color	Cause	Correction
Dead white	Running hot	Use colder type plug such as Champion No. 1 COMM, or equivalent.
Light brown	Normal	None
Glossy black	Oil in cylinder	Check rings and pistons. Replace worn and broken parts.
Dull black	Rich fuel mixture weak ignition, improper spark plug gap, or weak compression.	Check for presence of each suggested cause and make necessary repairs.

(4) Clean each spark plug on sand blast spark plug cleaner. Clean all sand from spark plug with compressed air.

(5) Adjust gap to 0.025 inch (wire-type feeler gage) by bending outer electrode.

(6) Test spark plugs under 110 pounds air pressure in a spark plug testing fixture. Replace plugs if spark appears weak, and coil and condenser test satisfactorily.

Section VIII**ENGINE ELECTRICAL SYSTEM—STARTING MOTORS****56. BENDIX DRIVE ASSEMBLY.**

a. Description (fig. 104). The Bendix drive consists of a threaded sleeve fastened to the starting motor armature shaft through a drive spring and a pinion mounted on the threads of the sleeve.

b. Operation. When the starting motor circuit is closed, the armature revolves, turning the sleeve within the pinion. The threads on the sleeve force the pinion to travel on the sleeve and, as it reaches the outer end of the sleeve, the external teeth of the sleeve mesh with the external teeth of the flywheel. The pinion turns the flywheel,

RA PD 78386

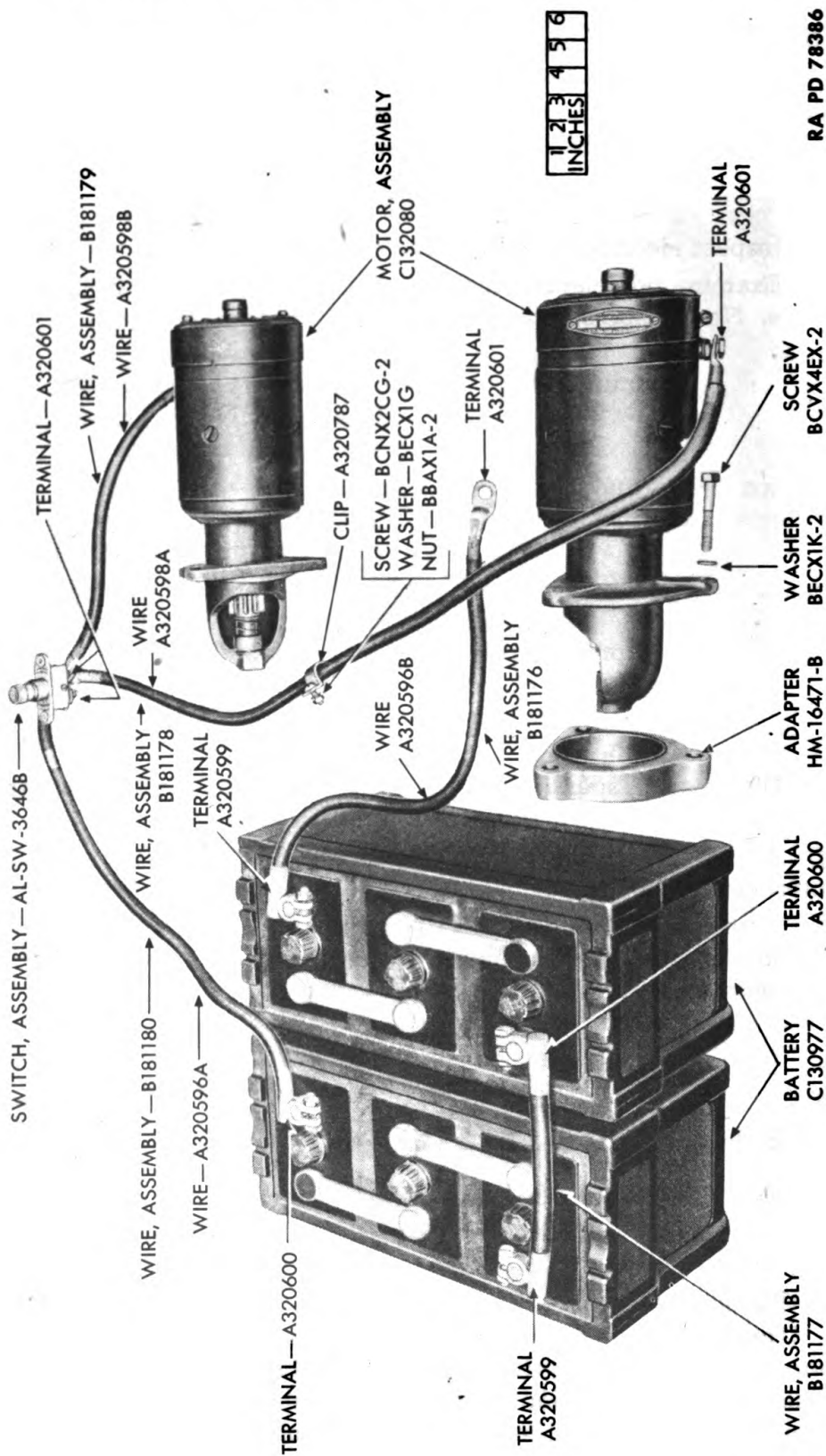
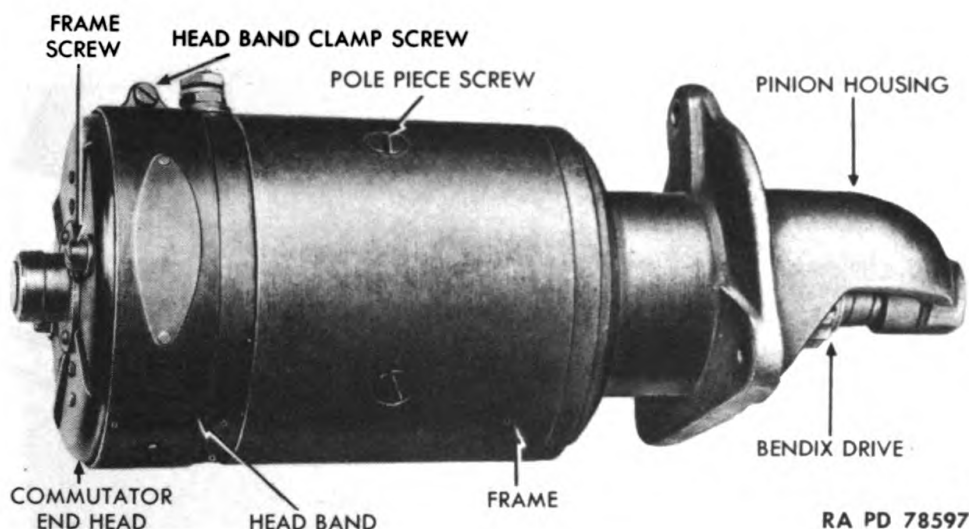


Figure 97—Starting System Components

ENGINE AND ACCESSORIES



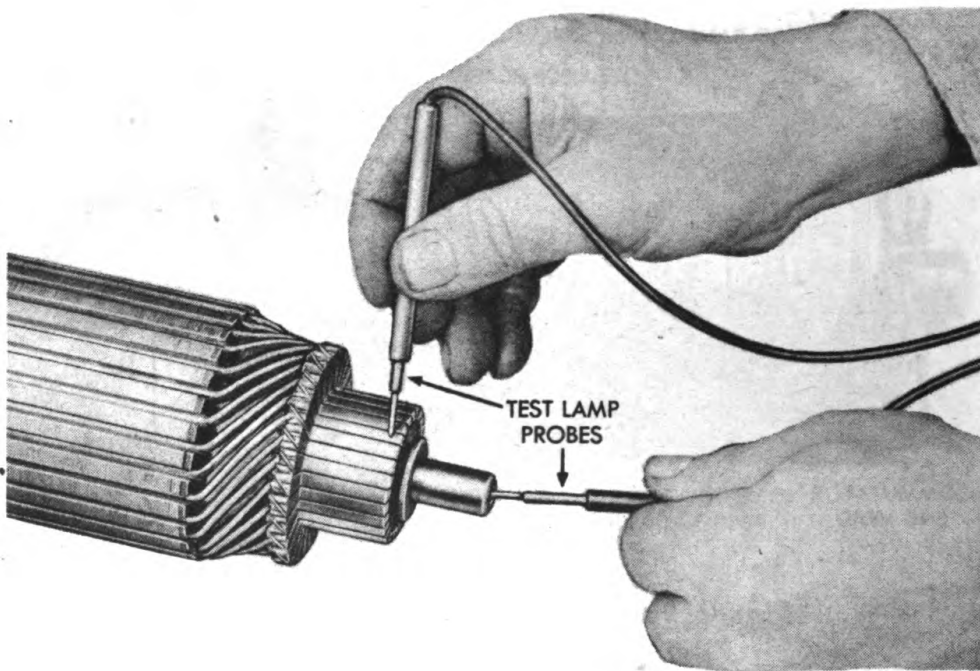
RA PD 78597

Figure 98—Starting Motor Removed

cranking the engine. When the engine fires and the rotating speed of the flywheel exceeds the speed of the pinion, the pinion is forced back on the threads of the sleeve, and is disengaged from the flywheel teeth.

57. STARTING MOTORS.**a. Disassembly (figs. 97 and 98).**

- (1) Loosen head band clamp screw and slide band from head.
- (2) Disconnect the two field coil lead wires from insulated brushes.
- (3) Remove the two frame screws and lock washers. Hold up brushes and pull commutator end head from frame. Slide thrust washer from armature shaft. Lift pinion housing from other end of frame. Slide armature from frame and field.
- (4) Remove spring shaft screw and spring head screw (each with a special lock washer) from Bendix drive. Pull pinion assembly and spring from armature shaft. Press driving head from shaft. Tap key from armature shaft. Slide intermediate bearing and washer from armature shaft.
- (5) Remove brush screws and brush lead wire ground screws. Lift brushes and brush ground connectors from commutator end head. Pull brush post clips from posts. Remove insulating washers, bushings, brush spring, brush holders, spring insulators, and brush holder spacing insulators from posts.



RA PD 78584

Figure 99—Testing Starting Motor Armature for Grounded Circuit

b. Inspection and Repair.

(1) ARMATURE.

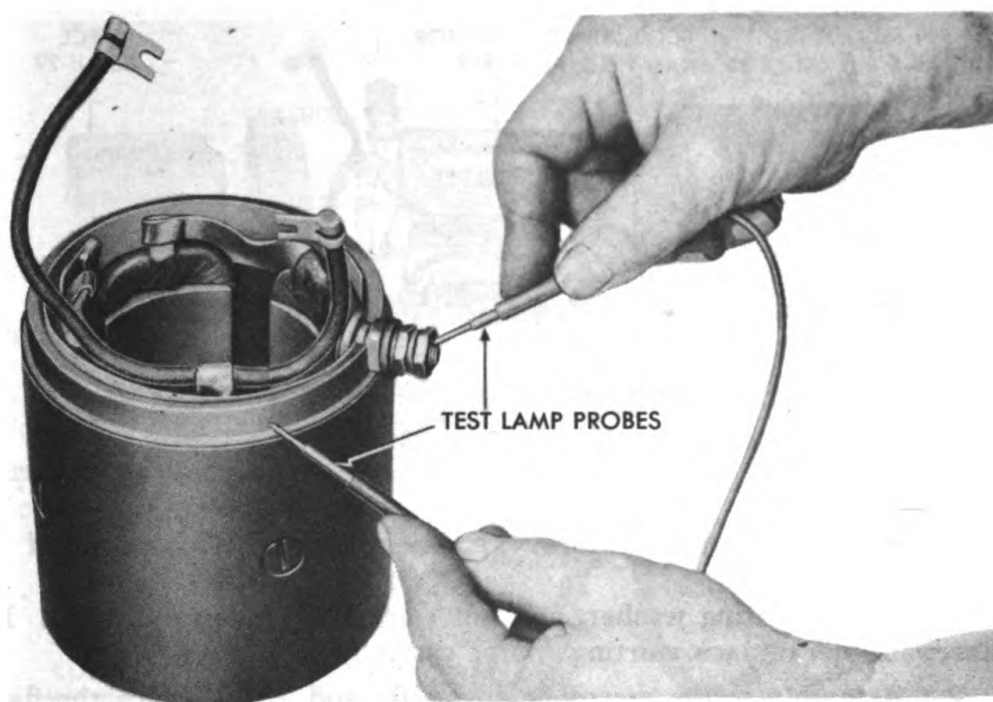
(a) *Clean Commutator.* If commutator is dirty or discolored, hold a piece of flint paper (No. 2/0) against the commutator while turning armature slowly. Blow sand off commutator after dressing.

(b) *Repair of Rough or Worn Commutator.* If commutator is rough or worn, place armature in a lathe. Take as light a cut as possible from commutator to remove roughness. Do not undercut mica between commutator bars. **NOTE: Lathe cutting tool must be sharp to avoid burring commutator. If burs are present after taking the cut, replace armature.**

(c) *Test Armature for Grounds* (fig. 99). Hold one probe of test lamp to the core or shaft (not on bearing surfaces). Touch each commutator segment with other probe of test lamp. If lamp lights at any time, the winding is grounded. Replace armature if grounded.

(d) *Test Armature for Shorts.* Place armature on a growler and turn on growler. Hold a thin strip of steel on the core. Rotate armature slowly by hand. If steel strip vibrates, armature is shorted. Replace armature if shorted.

ENGINE AND ACCESSORIES



RA PD 78583

Figure 100—Testing Starting Motor Field for Grounded Circuit

(e) *Test Armature for Open Circuit.* Touch probe of test lamp to each pair of adjacent commutator bars in turn. If lamp fails to light on any test, an open circuit is indicated. Replace armature if open.

(2) FRAME AND FIELD.

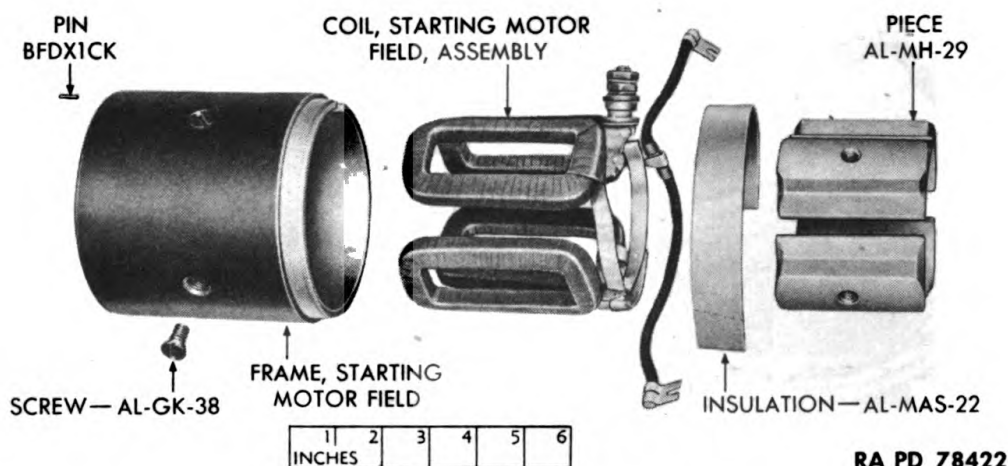
(a) *Test Field Coils for Grounds (fig. 100).* Bend the two loose leads so that neither touches frame or field. Hold one probe of test lamp on frame. Touch terminal post with other test lamp probe. If test lamp lights, a grounded circuit is indicated. To locate the grounded circuit, disassemble terminal post and repeat test. If test lamp still lights, ground is in field coil. If it no longer lights, the ground is in terminal post.

(b) *Test Field Coil and Leads for Open Circuit.* Hold one point of test lamp on terminal post. Touch each lead, in turn, with the other point of test lamp. If test lamp fails to light in either instance, a field coil or lead is open.

(c) *Repairing a Ground or Open Circuit in Frame Assembly.*

1. *Disassembly frame assembly (figs. 101 and 102).* Remove two nuts, insulating washer, and terminal post cover insulation from terminal post, and remove the four pole piece screws (figs. 101 and 102). Lift pole pieces and coils from frame. Lift terminal post frame

ORDNANCE MAINTENANCE—GENERATING UNIT M18

**Figure 101—Starting Motor Frame and Field Disassembled**

insulation, insulating washer, and flat washer from terminal post. If unrepairable, replace starting motor assembly.

2. **Assembly frame assembly** (figs. 101 and 102). Place the flat washer, insulating washer, and terminal post frame insulating bushing on the terminal post. Place the field coils, insulation, and pole pieces in position in frame. Dip pole piece screw in shellac. Install the pole piece screws. Strike the frame a few sharp blows with a rawhide mallet as the screws are being tightened to aline pole pieces. Install terminal post cover insulator, insulating washer, lock washer, nut, second lock washer, and second nut on the terminal post.

(3) PINION HOUSING.

(a) Clean pinion housing in dry-cleaning solvent, and dry with compressed air.

(b) Examine pinion housing for fractures.

(c) Fit armature shaft into the end bearing and check side play.

(4) BENDIX DRIVE AND INTERMEDIATE BEARING PLATE.

(a) Clean all parts in dry-cleaning solvent, and dry with compressed air. Examine all parts to see if they are broken, bent, chipped, or worn.

(b) Inspect the intermediate bearing plate for wear or distortion. Fit intermediate bearing on armature shaft and check for side play. Spin plate on shaft, and note if it is warped.

(5) COMMUTATOR END HEAD.

(a) Clean commutator end head and all parts except brushes and fiber insulators in dry-cleaning solvent. Blow dry with compressed air.

(b) Inspect all parts for scoring, distortion, and breakage.

ENGINE AND ACCESSORIES

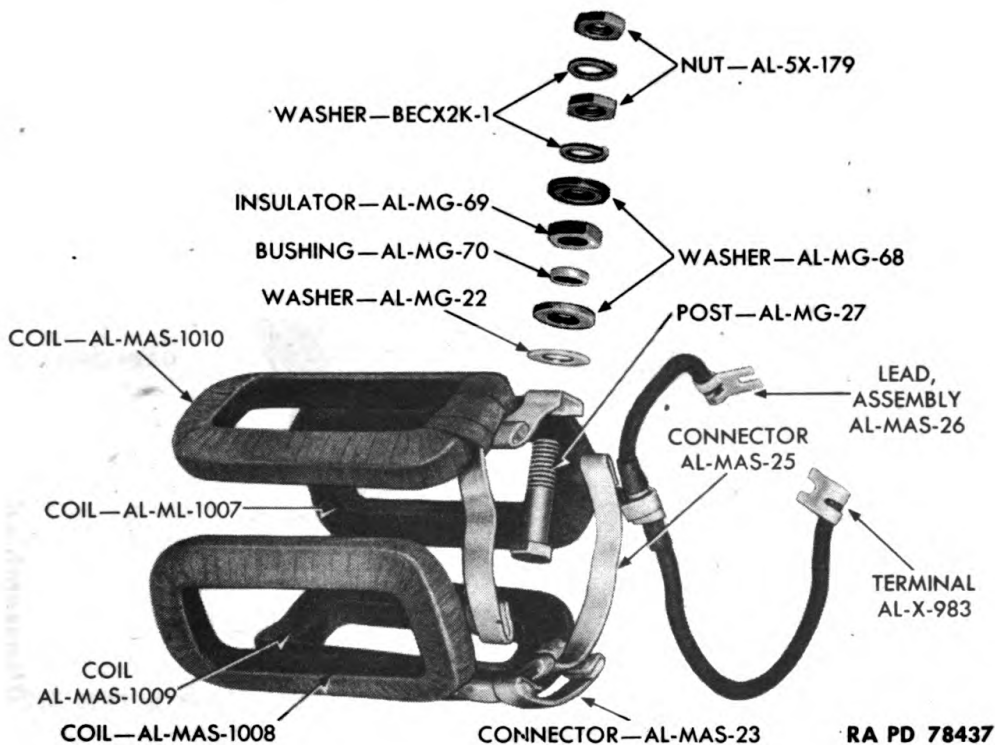


Figure 102—Starting Motor Field Disassembled

(c) If brushes are worn to less than half their original length, replace with new ones. Compare the old brush with a new one to determine the amount of wear.

c. Assembly (fig. 103).

(1) On brush holder posts on inside of commutator end head, install brush holder spacing insulators, spring insulators, brush holders, brush springs, insulating bushings, and washers. Install brush post clips on posts (fig. 105).

(2) Place brushes and ground connectors in position within commutator end head. Install brush lead ground screws. Install brush screws (fig. 105).

(3) Coat bearing and bearing surface on armature shaft with engine oil (SAE 10), and slide washer and intermediate bearing plate into position on armature shaft.

(4) Tap key to seat in keyway on armature shaft. Slide Bendix drive head over key and shaft and press onto shaft until screw hole in head and shaft are aligned.

(5) Slip spring and pinion assembly into position on armature shaft. Aline screw holes in spring and heads, and install special washer

ORDNANCE MAINTENANCE—GENERATING UNIT M18

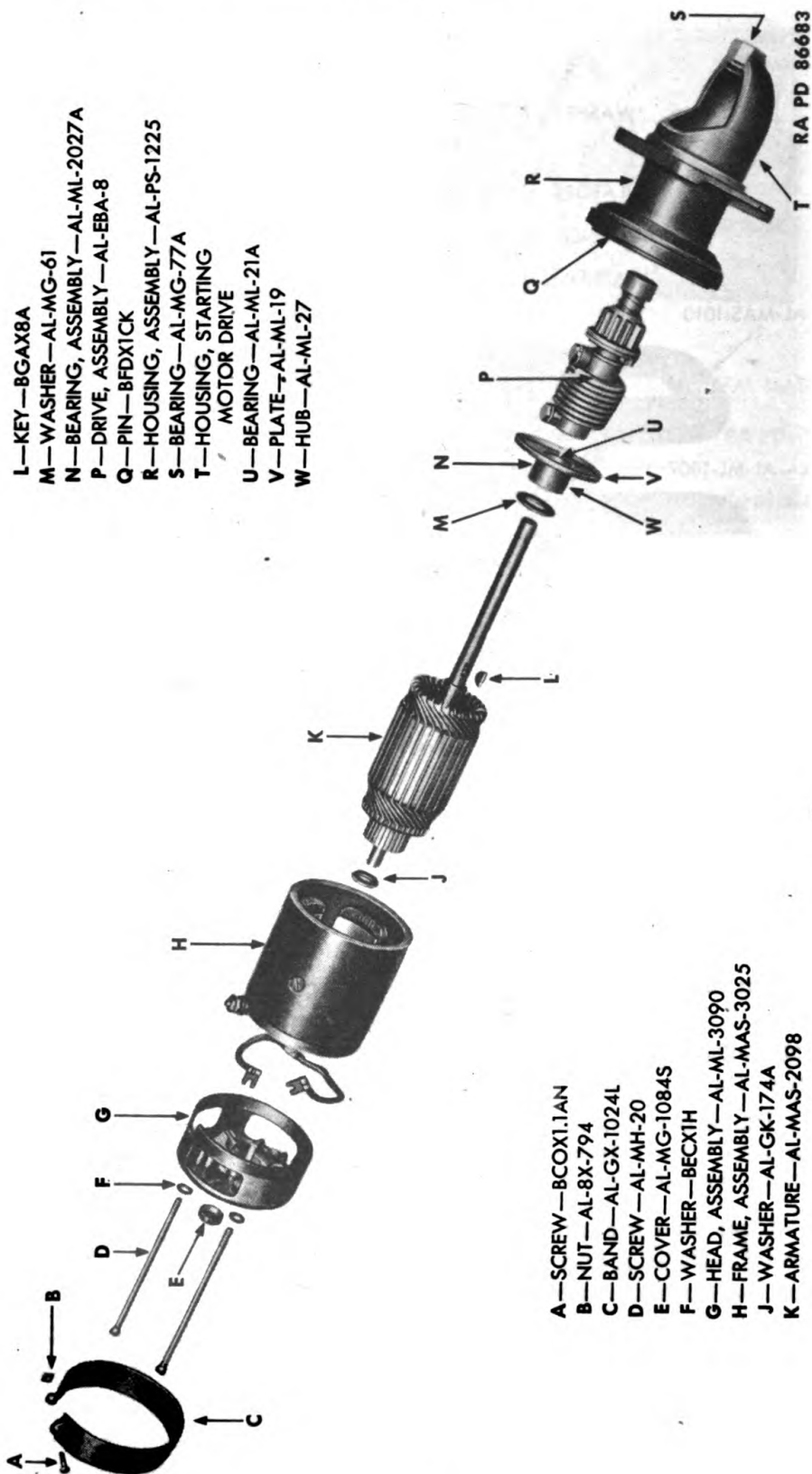
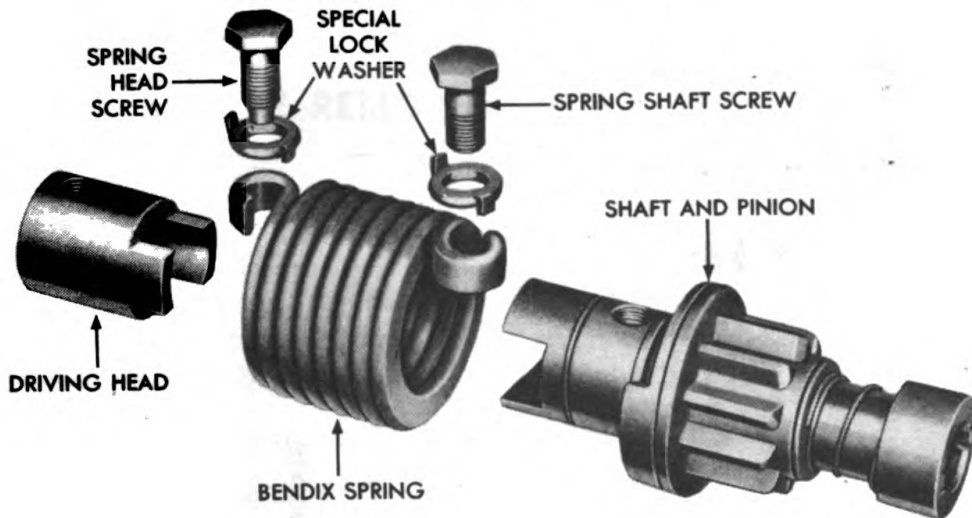


Figure 103—Starting Motor Disassembled

ENGINE AND ACCESSORIES



RA PD 79575

Figure 104—Bendix Drive Disassembled

and spring shaft screw. Also install special washer and spring head screw (doweled). Tighten both screws securely and bend ears on special washers to lock screws (fig. 104).

(6) Coat bearings in pinion housing and commutator end head, as well as bearing surfaces on armature with engine oil (SAE 10).

(7) Slide pinion housing over Bendix drive. Make certain intermediate bearing plate is tight against its seat in housing, with dowel in housing through slot in plate.

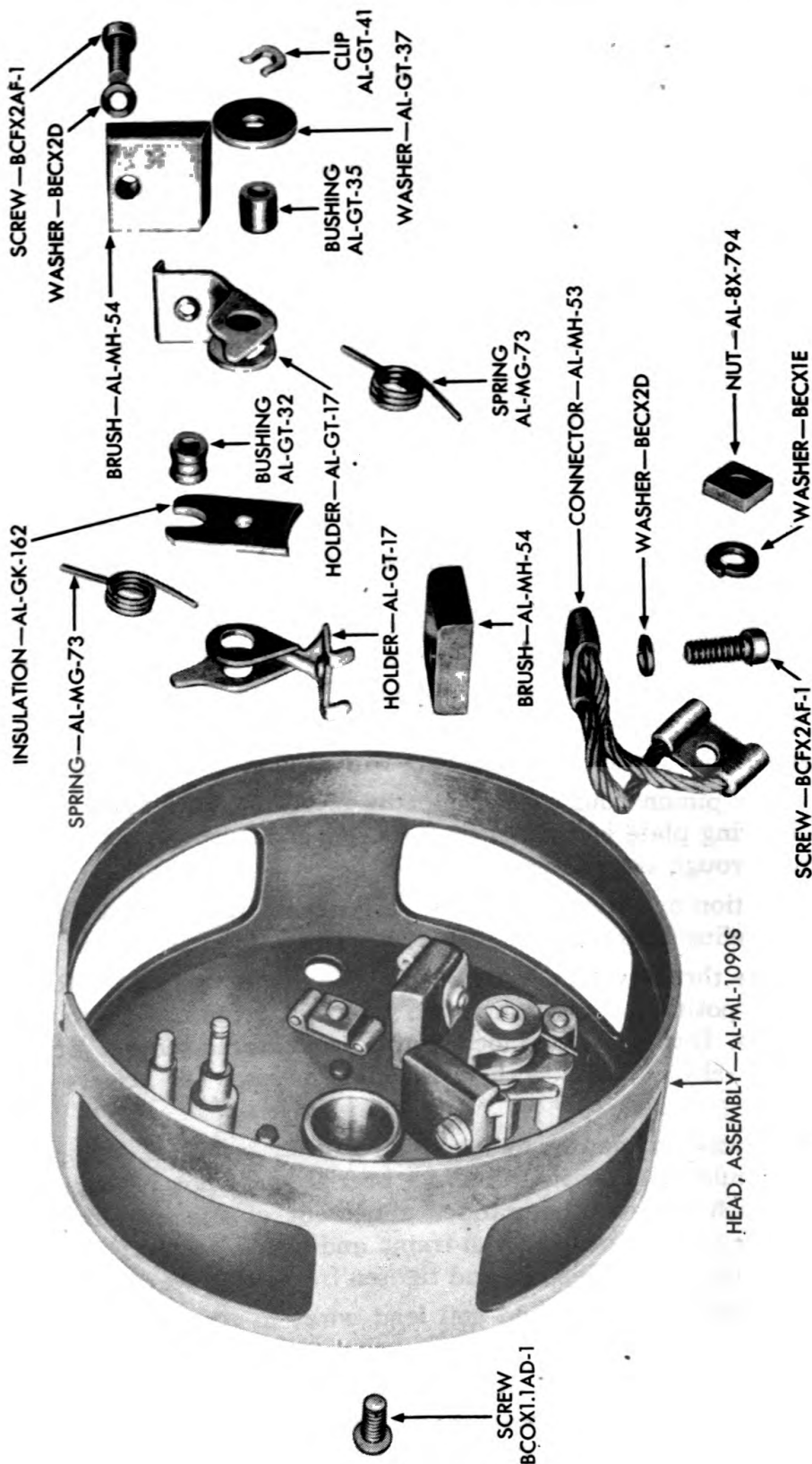
(8) Position armature and pinion housing in frame and field assembly, and align pinion housing on dowel projecting from frame.

(9) Slide thrust washer onto front end of armature shaft. Raise brushes and position commutator end head on armature shaft and against frame. Install the two lock washers and frame screws. Strike frame a few sharp blows with a rawhide hammer as screws are tightened.

(10) Revolve armature to assure proper assembly of the components. Should bind exist, the three bearings are not in line, the cause of which is usually improper alignment of the intermediate bearing. Slide pinion housing from frame and check position of intermediate bearing plate. Replace and tighten frame screws.

(11) Connect the two field coil lead wires to the two insulated brushes.

(12) Position head band over openings in commutator end head and tighten clamp screw. If bearing cover was removed, tap it to seat over shaft boss on outside of commutator end head.



RA PD 78405

Figure 105—Starting Motor Commutator End Head Disassembled

ENGINE AND ACCESSORIES**Section IX****ENGINE REMOVAL AND DISASSEMBLY****58. REMOVAL.**

a. General. There are two alternatives for engine removal. Engine and generator assembly can be removed as a unit, or engine can be removed alone. Choose the method which fits the purpose of the removal. Both alternatives are given below, engine and generator assembly in subparagraph **b**, engine alone in subparagraph **c**.

b. Engine and Generator Assembly Removal.

(1) Remove all four doors, all four side panels, hood, instrument panel (par. 92), battery and tool box shelf, rear upright frame, center upright frame and radiator (par. 28 a).

(2) Drain oil from engine and screw drain pipe from elbow on under side of oil pan.

(3) Remove exhaust tube and muffler.

(4) Remove the six nuts, lock washers, and bolts which attach engine and generator assembly to main frame.

(5) Remove rear fan cover from rear of generator.

(6) Attach a hoist to a chain looped around rear of generator (between exciter field support bracket and rear fan) and front of engine (between oil pan and front support bracket) (fig. 106). Lift hoist enough to take slack out of chain. Check chain position to be sure it will not damage engine accessories; especially distributor. Remove distributor cap if necessary to clear chain. Lift assembly from frame and lower onto blocks placed beneath generator mounting flanges and engine front support (fig. 107).

(7) Support engine with a hoist (fig. 108). Disassemble engine from generator (par. 81) and swing engine away from generator (fig. 109).

c. Removal of Engine Alone (figs. 110 and 111).

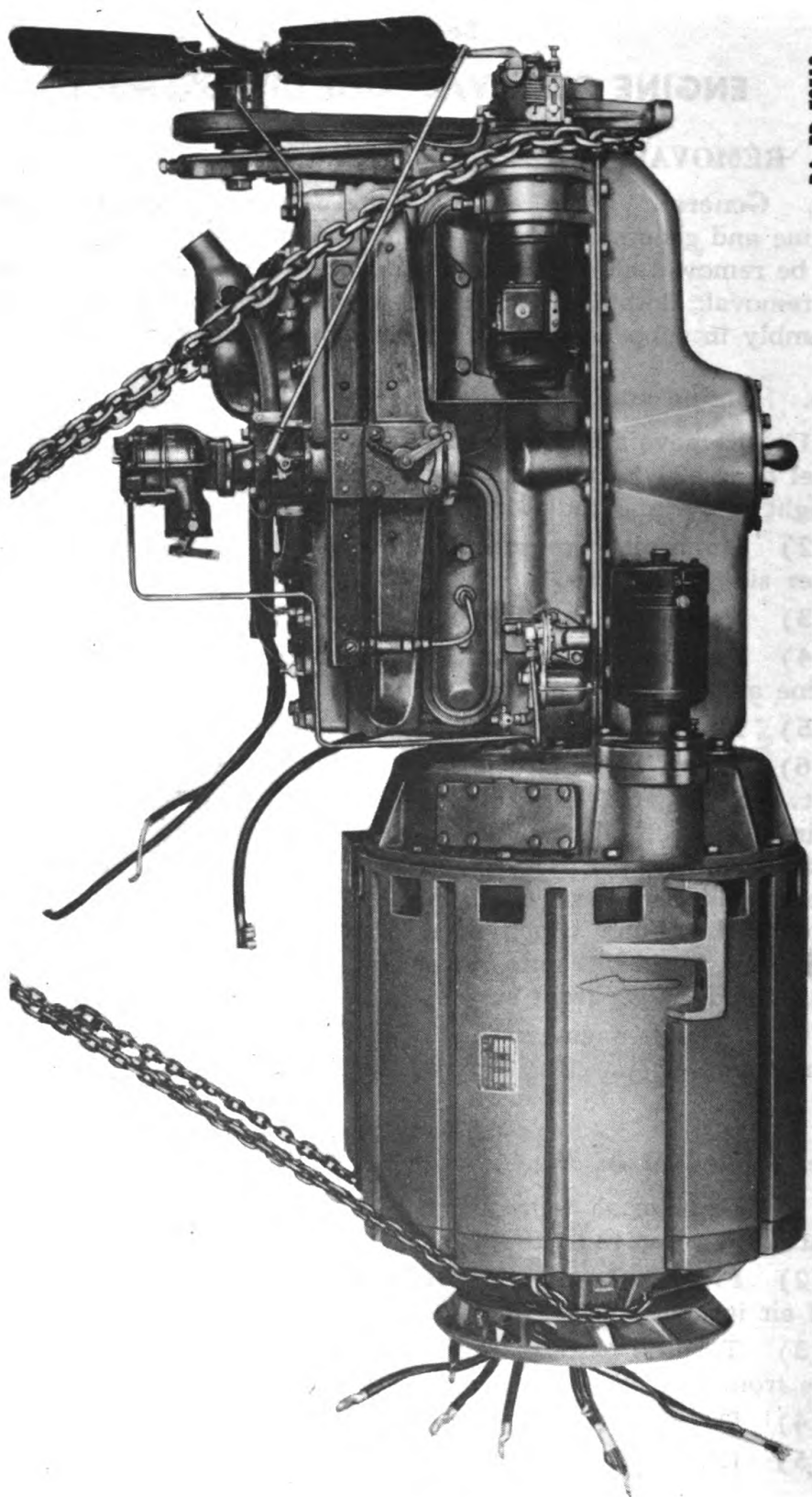
(1) Remove all four doors, all four side panels, hood, radiator (par. 28 a), and radiator base support.

(2) From carburetor, disconnect throttle control, choke control, and air intake elbow.

(3) Turn off gasoline at valve in tube near tank and disconnect tube from fuel pump.

(4) Disconnect "CG" wire from two-charge regulator.

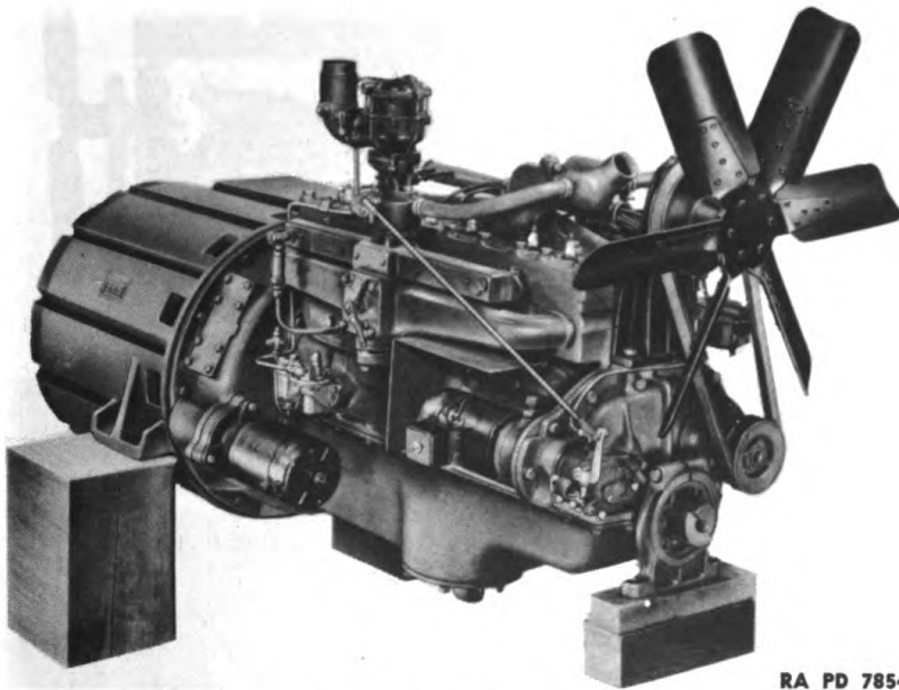
(5) Disconnect terminal block to ignition coil wire from ignition coil.



RA PD 78513

Figure 106—Method of Hoisting Engine and Generator Assembly

ENGINE AND ACCESSORIES



RA PD 78541

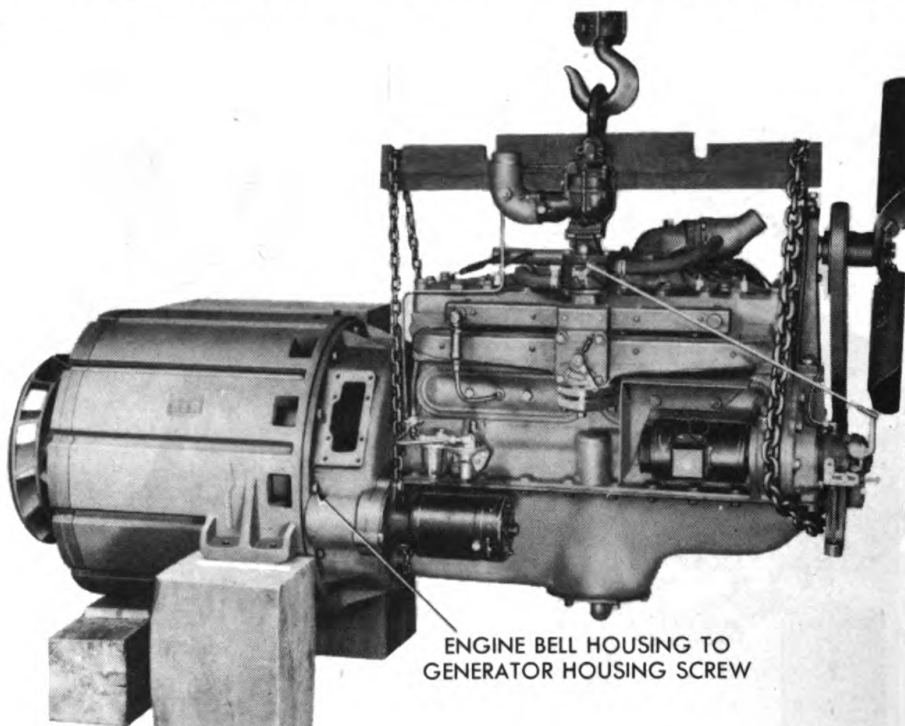
Figure 107—Method of Blocking Engine and Generator Assembly

- (6) Remove exhaust tube and muffler (pars. 41 a and 42 a).
- (7) Disconnect starting motor cable from each starting motor.
- (8) Drain engine oil and screw oil drain pipe from elbow on under side of oil pan.
- (9) Disconnect engine temperature gage bulb from left rear corner of cylinder head.
- (10) Disconnect oil pressure gage tubing from base of oil filter.
- (11) Support engine with a sling attached to a hoist and detach engine from generator (par. 81).
- (12) Remove the two nuts, lock washers, and bolts which attach front engine support (fig. 92) to main frame.
- (13) Swing engine forward to clear generator and hoist from unit. Lower engine into an engine stand or onto blocks placed under front engine support and each side of bell housing.

59. REMOVAL OF ACCESSORIES.

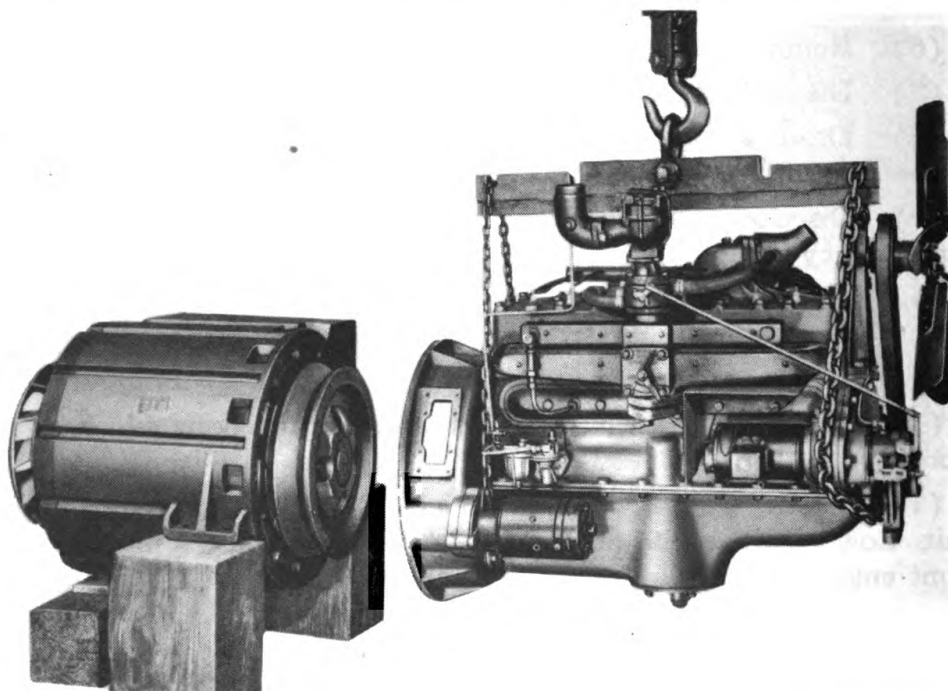
a. Remove following assemblies per instructions in TM 9-617: fan belt, fan and bracket, bayonet-type oil gage, thermostat with housing, bypass, water pump, carburetor, throttle body, manifold,

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78557

Figure 108—Separating Engine From Generator (1)



RA PD 78542

Figure 109—Separating Engine From Generator (2)

ENGINE AND ACCESSORIES

- A—IGNITION COIL
- B—CARBURETOR
- C—CHOKE CONTROL
- D—THROTTLE CONTROL
- E—ENGINE TEMPERATURE GAGE BULB
- F—BELL HOUSING TO GENERATOR
- G—CRANKING MOTOR CABLE
- H—OIL DRAIN PIPE
- J—CRANKING MOTOR
- K—OIL PRESSURE GAGE TUBING
- L—OIL FILTER
- M—TERMINAL BLOCK TO IGNITION COIL WIRE
- N—RADIATOR BASE SUPPORT
- P—RADIATOR

RA PD 79567

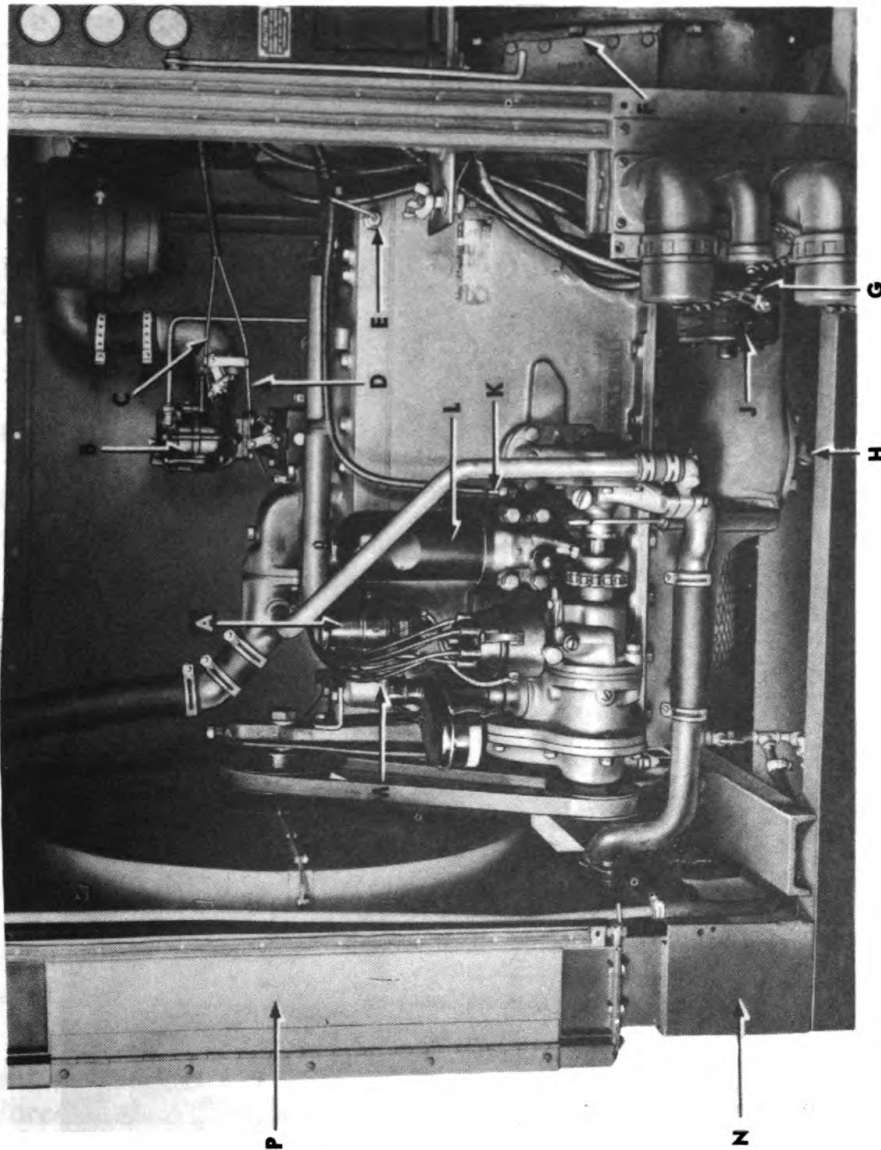


Figure 110—Disconnection Points for Engine Removal—Left Side

ORDNANCE MAINTENANCE—GENERATING UNIT M18

- A—AIR INTAKE ELBOW
- B—CARBURETOR
- C—"CG" WIRE
- D—FRONT ENGINE SUPPORT
- E—MAIN FRAME
- F—TWO-CHARGE REGULATOR
- G—MUFFLER
- H—EXHAUST TUBE
- J—FUEL PUMP
- K—CRANKING MOTOR
- L—CRANKING MOTOR CABLE

RA PD 79570

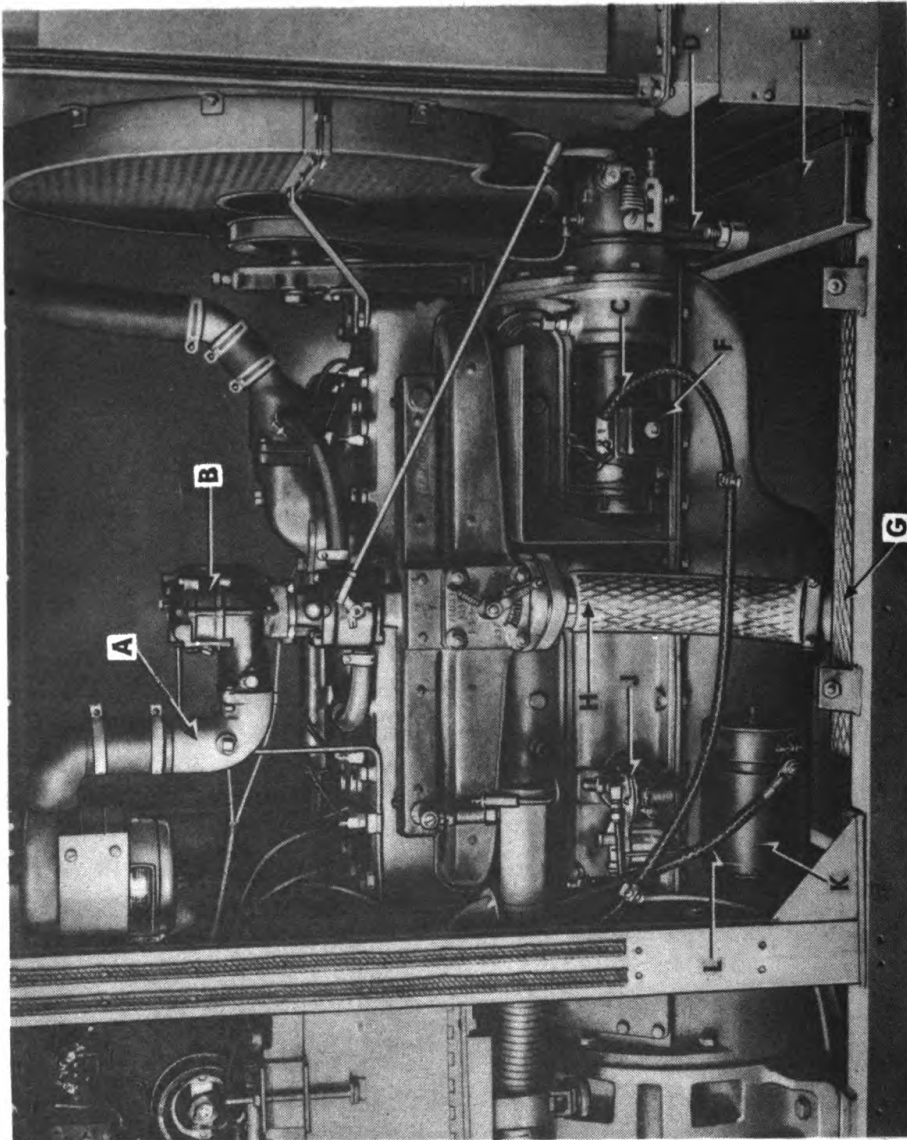


Figure 111—Disconnection Points for Engine Removal—Right Side

ENGINE AND ACCESSORIES

fuel pump, battery charging generator, spark plugs, ignition coil, and both starting motors (figs. 12 and 13).

b. Disconnect oil line from elbow on governor. Remove nut and disconnect governor linkage rod from governor. Remove the two cap screws and lock washers which secure governor to engine. Lift governor and gasket from engine (fig. 13).

c. Pull oil filler pipe and breather assembly from oil pipe adapter on water pump drive housing.

d. Remove distributor hold-down screw and lock washer, and loosen distributor clamp screw. Lift distributor from water pump drive (fig. 12).

e. Remove the two cylinder head cap screws which attach spark plug wire tube to head. Lift tube from head.

60. DISASSEMBLY.

a. Remove Subassemblies.

(1) Pull the two cotter pins which hold water pump drive shaft pulley drift pin in place. Drive drift pin from pulley and water pump drive shaft. Pull pulley from shaft and pull key from keyway in shaft (fig. 112).

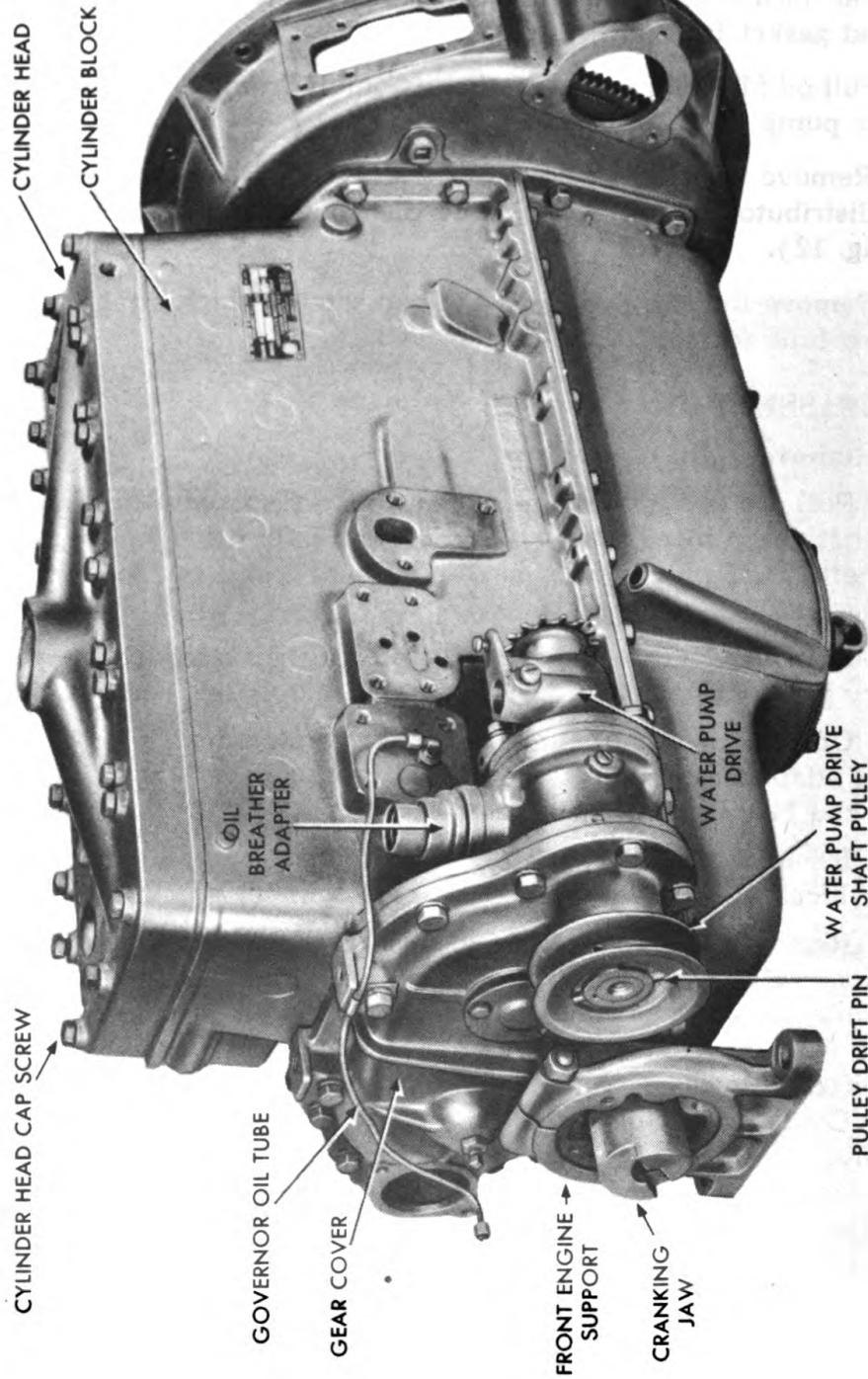
(2) Remove the three cap screws and lock washers which attach accessory pump drive housing and lift housing from engine (fig. 112).

(3) Only if necessary for repair or replacement, loosen oil breather adapter by holding a soft block against its lower lip and tapping the block with a hammer (fig. 112).

(4) Remove the 29 cap screws which attach cylinder head to cylinder block. Lift head and gasket from cylinder block (fig. 112).

(5) Remove the two screws and lock washers which secure each of the two valve chamber covers to cylinder block (fig. 113). Lift covers and gaskets from engine and plug holes in bottom of valve chamber with rags to prevent the loss of valve pins. Insert a valve spring lifter between a valve spring seat and valve tappet cluster casting. Compress spring and lock lifter. Pull valve spring seat pin from valve stem (fig. 114). Lift valve from top of cylinder block. Repeat the operation to remove the remaining 11 valves. Keep valves in order after removal to insure the return of each valve to its original location.

(6) Compress valve spring as much as possible with lifter. Insert screwdriver to hold valve spring under tension. Slide out lifter. Force valve spring and seat from chamber with screwdriver (fig. 115). Similarly remove remaining 11 valve springs and seats.



RA PD 78589

Figure 112—Engine With Accessories Removed—Left Front View

ENGINE AND ACCESSORIES

RA PD 78592

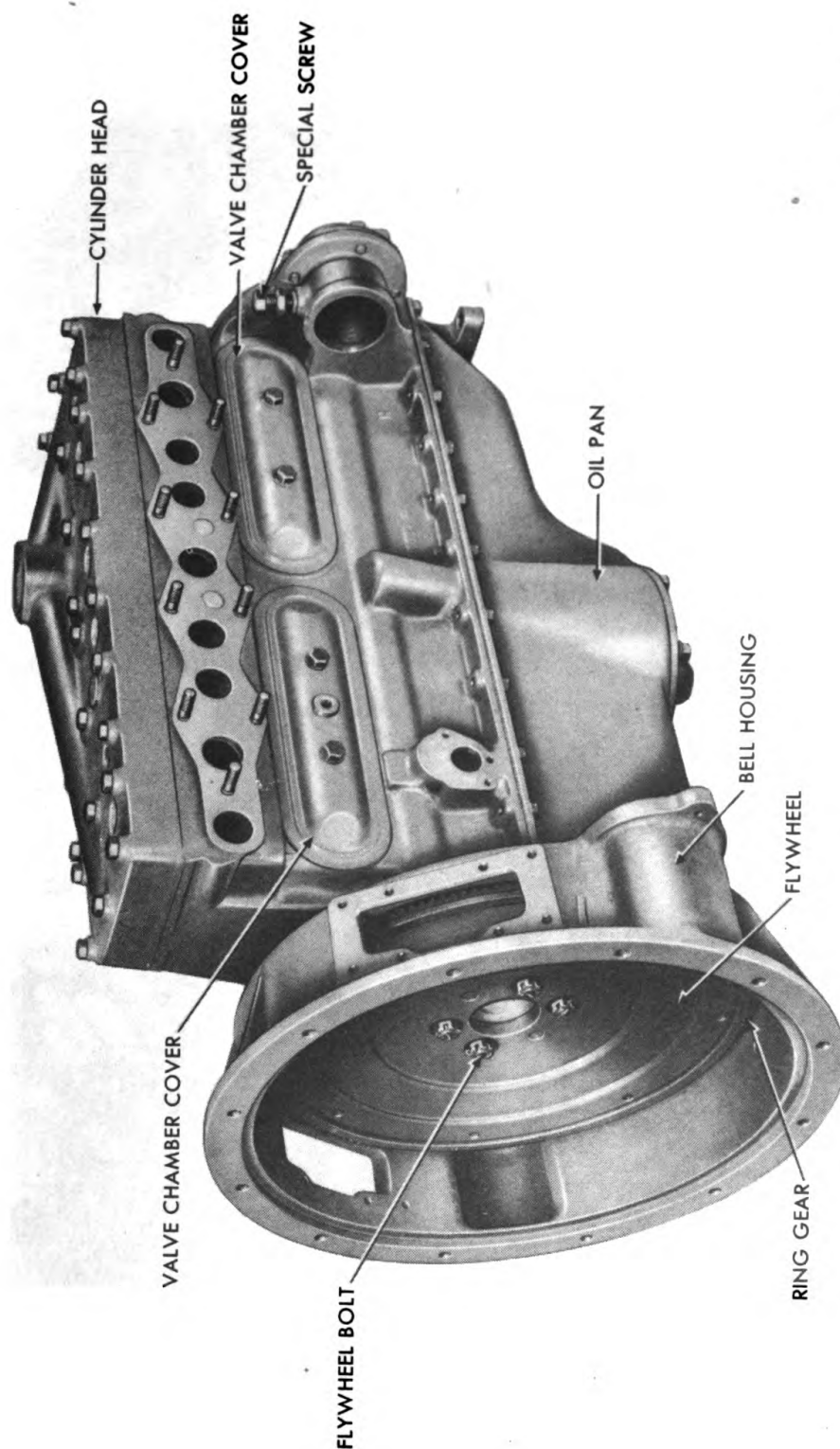
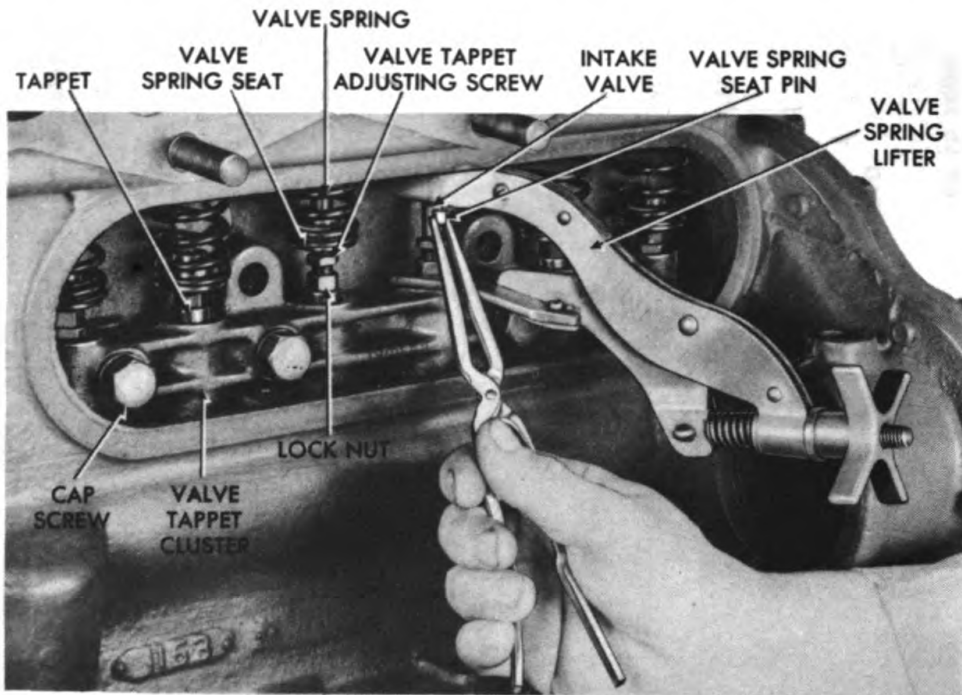


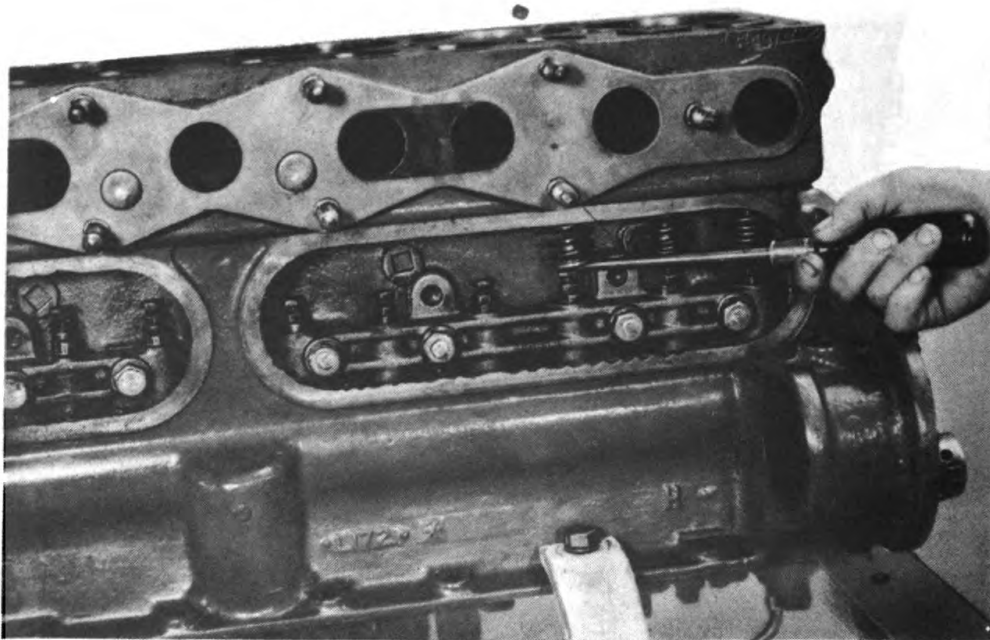
Figure 113—Engine With Accessories Removed—Right Rear View

ORDNANCE MAINTENANCE—GENERATING UNIT M18



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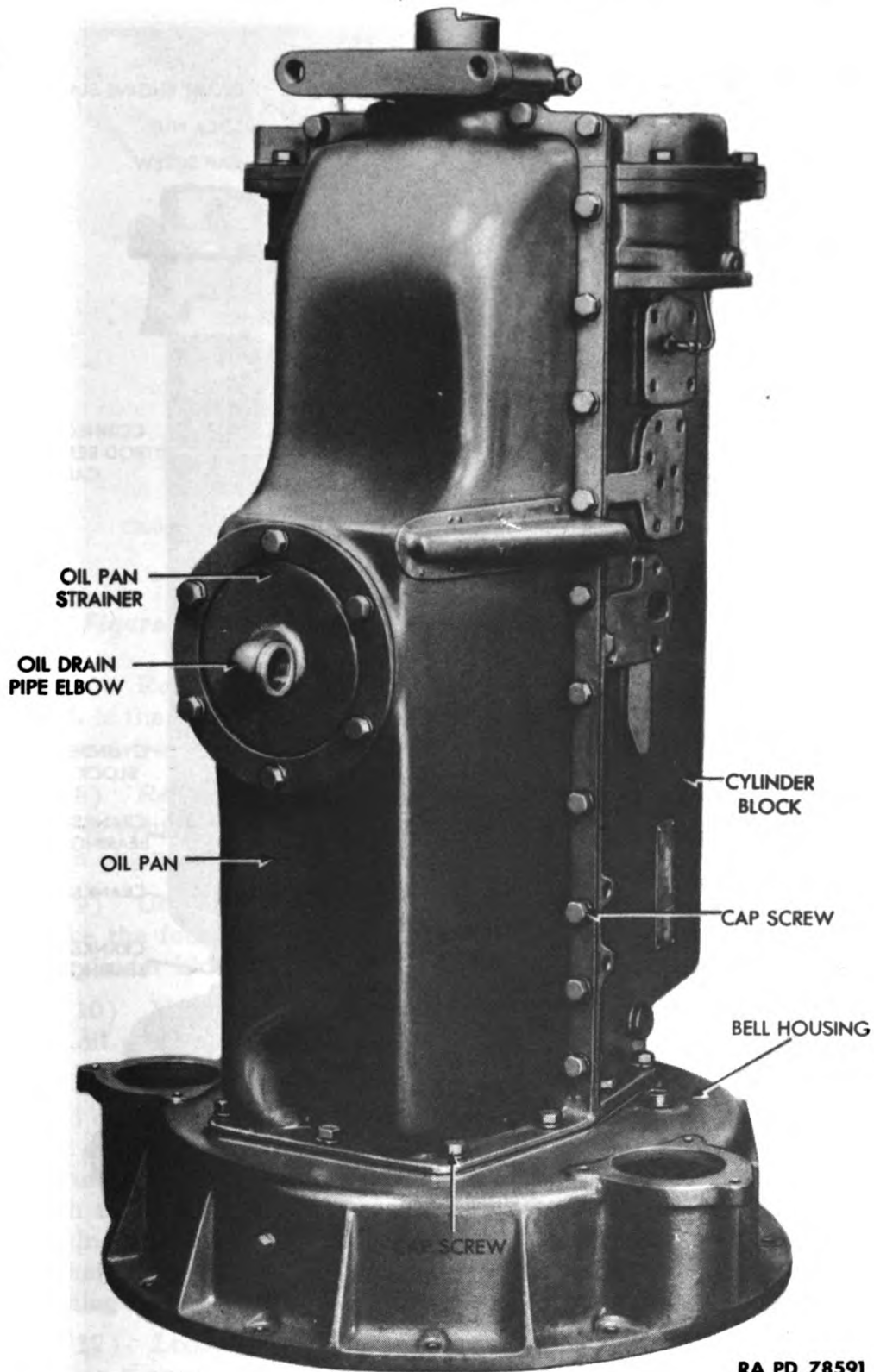
Figure 114—Valve Removal



RA PD 70366

Figure 115—Valve Spring Removal

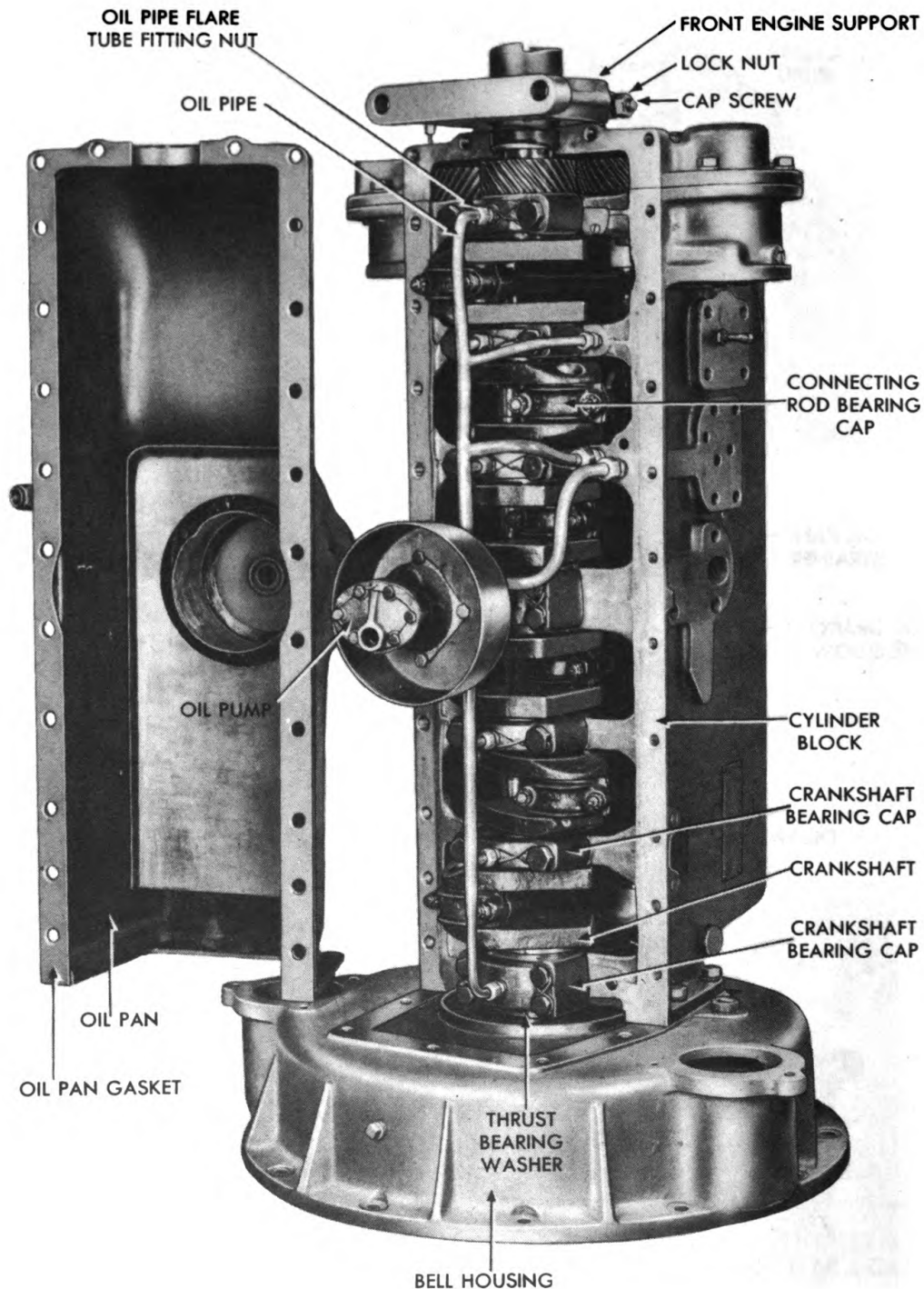
ENGINE AND ACCESSORIES



RA PD 78591

Figure 116—Engine With Accessories Removed—Underside View

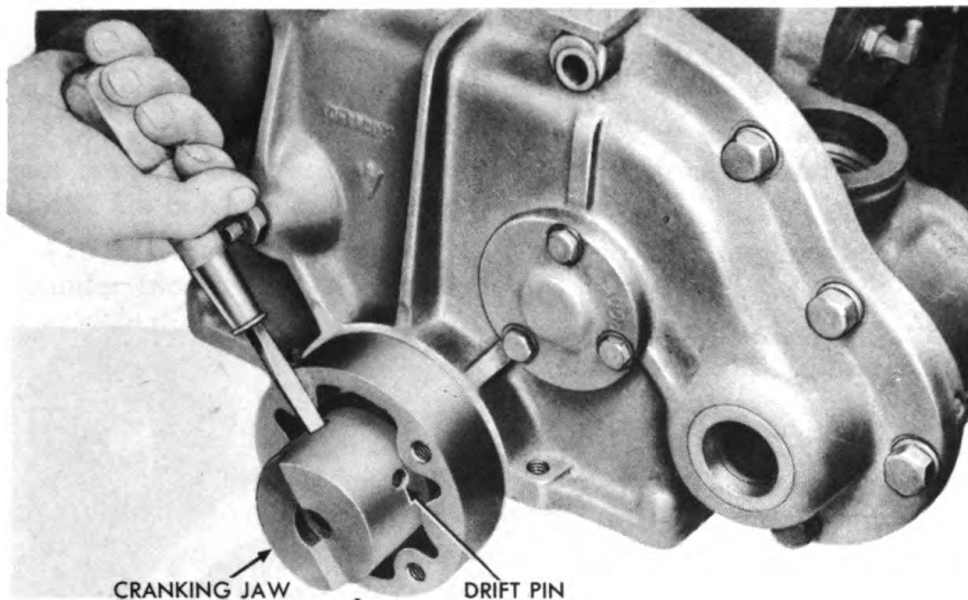
ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78616

Figure 117—Underside of Engine—Oil Pan Removed

ENGINE AND ACCESSORIES



RA PD 78602

Figure 118—Cranking Jaw Drift Pin Set Screw Removal

(7) Remove the four cap screws and lock washers which attach each of the two valve tappet clusters (fig. 114) to cylinder block. Lift clusters from engine.

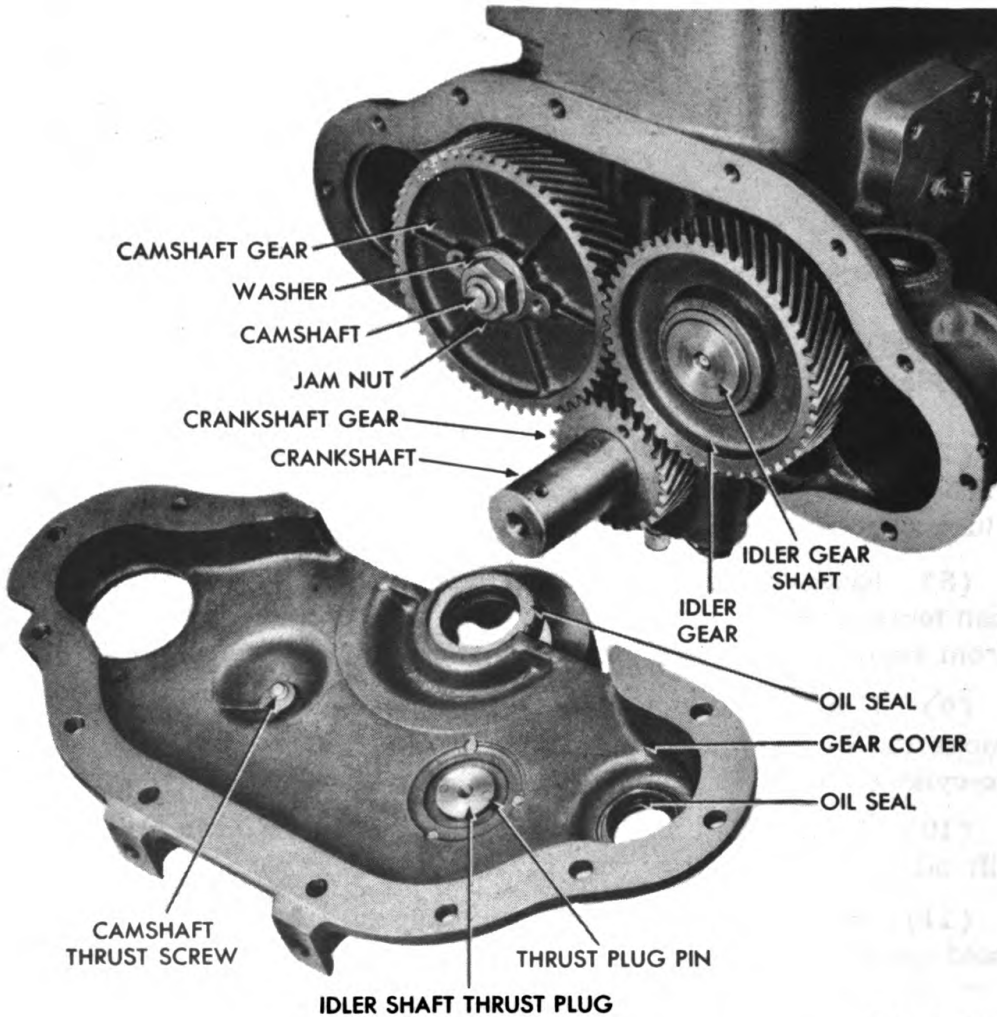
(8) Remove the 29 cap screws and lock washers which hold oil pan to cylinder block and bell housing (fig. 116). Lift pan and gasket from engine (fig. 117).

(9) Unscrew oil pipe sleeve nut from fitting on oil pump. Remove the four cap screws and lock washers which attach oil pump to cylinder block (fig. 55).

(10) Unscrew all oil pipe flare tube fitting nuts from fittings and lift oil pipe from engine (fig. 117).

(11) Pull cotter pins from castellated nuts on cap screws which hold connecting rod bearing caps in place. Remove nuts, shims, caps, and cap screws. Force connecting rod and piston assembly up through engine block. Rejoin connecting rod bearing cap to connecting rod with the shims returned to the position to facilitate the keeping of mating rod and shims (from which they were removed) and cap together. Repeat the procedure to remove the remaining five connecting rod and piston assemblies.

(12) Loosen lock nut on horizontal cap screw at top of front engine support (fig. 132). Loosen cap screw and slide support from engine.



RA PD 78619

Figure 119—Front of Engine—Gear Cover Removed

ENGINE AND ACCESSORIES

(13) Remove set screw which holds drift pin through cranking jaw and crankshaft at front end of crankshaft (fig. 118). Drive pin from jaw and shaft. Pull jaw from shaft.

(14) Remove the 10 cap screws and lock washers which attach gear cover to front end of cylinder block. Lift cover and gasket from block. Do not lose oil seal (fig. 119).

(15) Screw governor oil tube nut from fitting on left side of cylinder block. Lift tube from engine (fig. 112).

(16) Lift idler gear and shaft from front end of cylinder block. Slide camshaft and gear assembly from front end of cylinder block. Use care to keep from injuring bearings with cams.

(17) Pull cotter pins which safety the four castellated nuts to flywheel studs on rear end of crankshaft (fig. 113). Remove castellated nuts. Lift flywheel from crankshaft. To facilitate removal, pry on flywheel or place wooden block against flywheel through openings in front of bell housing and drive flywheel from crankshaft.

(18) Cut and pull wires from each pair of crankshaft main bearing cap screw heads. Remove cap screws. Lift bearing caps, shells, and shims from cylinder block. Mark back of each shell with number corresponding to that on its cap so that it will be reassembled in the same order, provided no new shell is required. ●

(19) Carefully pry brass thrust bearing washer sections from between end flange on flywheel and engine block (fig. 117).

(20) Remove the six cap screws and lock washers (two inside bell housing, four outside bell housing) which attach bell housing to cylinder block. Lift bell housing from cylinder block.

(21) Lift crankshaft from cylinder block.

(22) By hand, push down on one end of each crankshaft upper bearing shell until it rotates in bearing web enough to get fingers under shell. Lift shells from cylinder block. Mark each shell on its back with a number corresponding to its position in cylinder block. This will insure assembly in original position, provided no new shell is required.

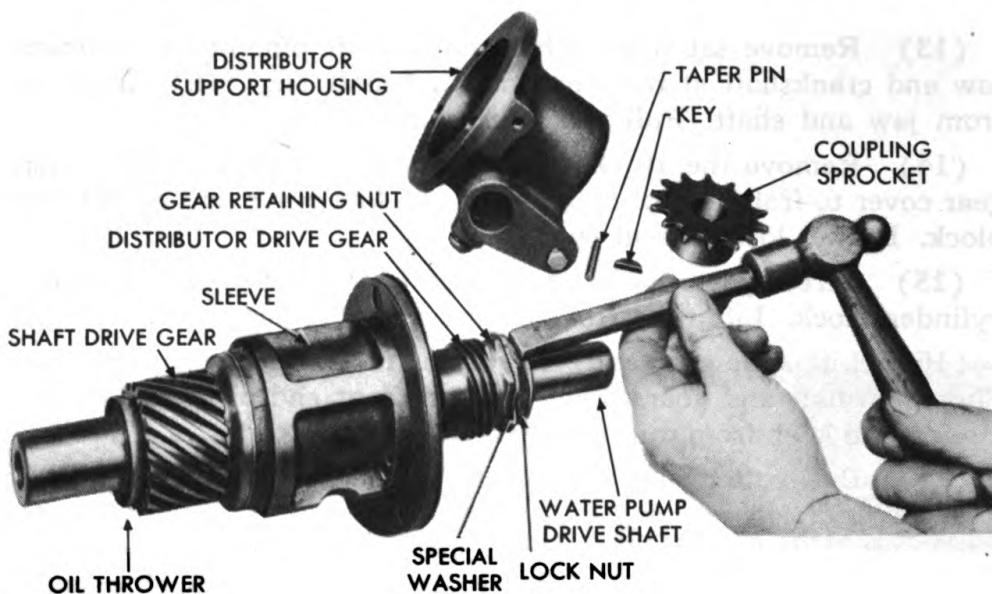
b. Disassemble Water Pump Drive (fig. 120).

(1) Drive taper pin from coupling sprocket and shaft. Press sprocket from rear end of shaft. Pull key from keyway in shaft.

(2) Slide housing from rear end of shaft. Press oil seal from housing.

(3) Straighten special washer and remove lock nut from rear end of shaft. Slide washer from shaft. Remove gear retaining nut from shaft.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78603

Figure 120—Water Pump Drive Disassembly

(4) Slide or press distributor drive gear and thrust washer from rear end of shaft. Pull key from keyway in shaft.

(5) Slide sleeve and thrust washer from rear end of shaft and press bushing from sleeve.

(6) Press oil thrower and shaft drive gear from front end of shaft. Pull key from keyway in shaft.

c. **Disassemble Valve Tappet Cluster** (fig. 114). Pull tappets from bottom of clusters. Loosen lock nut on each valve tappet adjusting screw. Remove screws from tappets. Screw nuts from screws.

d. **Disassemble Oil Pan** (fig. 116). Remove the six screws and lock washers which attach oil pan strainer to oil pan. Lift strainer and gasket from pan. Screw elbow from strainer.

e. **Disassemble Oil Pump**. Refer to paragraph 47 b.

f. **Disassemble Connecting Rod and Piston Assembly** (fig. 133).

(1) Expand the top compression ring and slide it from the top of the piston. Similarly remove the two remaining compression rings and one oil ring.

(2) Remove piston pin retaining screws and lock washers. Tap pin from piston and connecting rod. Lift rod from piston.

g. **Disassemble Gear Cover** (fig. 119).

(1) Slide oil seal from its seat on under side of gear cover.

ENGINE AND ACCESSORIES

(2) Remove the three cap screws and lock washers which attach idler shaft thrust plug plate to gear cover. Lift plate and shims from cover. Pull plug and two thrust plug pins from plate.

(3) Loosen lock nut on camshaft thrust screw. Remove screw from gear cover. Screw lock nut from screw.

h. Remove Gear From Camshaft (fig. 119).

(1) Remove jam nut and washer from front end of camshaft.

(2) Press shaft from gear. Pull key from keyway in shaft.

i. Remove Idler Gear From Shaft (fig. 119).

(1) Slide thrust washer from shaft.

(2) Press shaft from gear. Pull key from keyway in shaft.

Section X

INSPECTION OF DISASSEMBLED ENGINE

61. ENGINE COMPONENT CLEANING.

a. Soak all aluminum parts in dry-cleaning solvent. Dry with a clean cloth. Soak all steel parts in dry-cleaning solvent. Leave them only long enough to dissolve all grease and dirt. Blow solvent from passages with compressed air and wipe parts dry with a clean cloth.

b. Clean carbon from piston ring grooves with piston ring groove cleaner or with a broken piston ring ground flat on the end.

c. Clean cylinder block with grease-cleaning compound and rinse with clean water.

d. Strip all gaskets from machined surfaces where sealing compound has been used. Clean the surfaces by scraping and washing them with dry-cleaning solvent.

62. CYLINDER BLOCK AND CYLINDER HEAD INSPECTION.

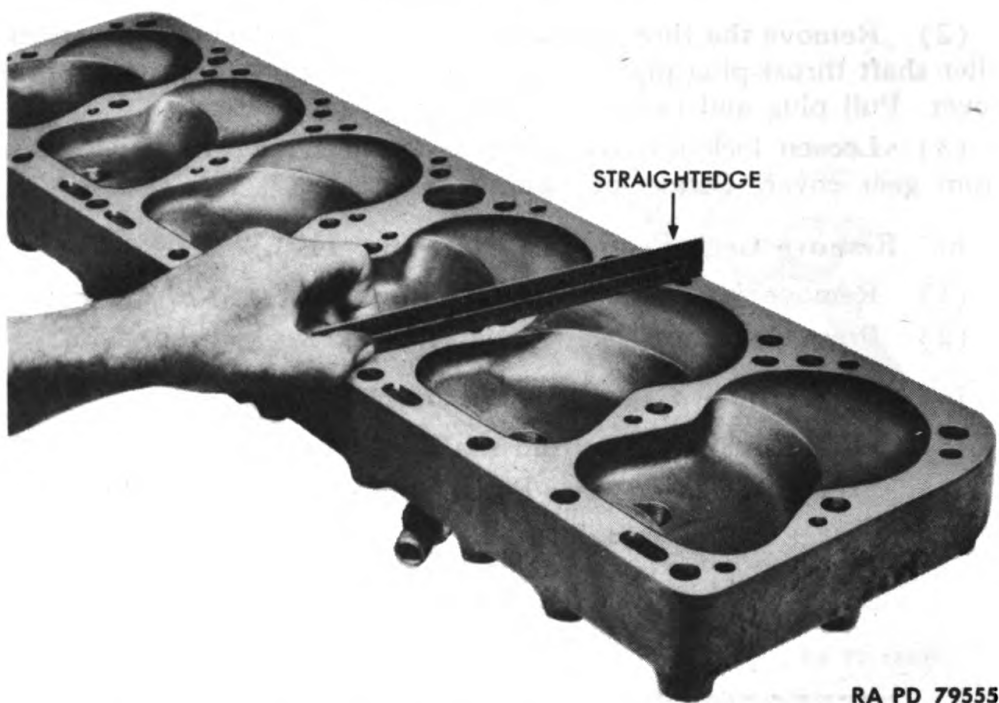
a. Cylinder Head.

(1) Examine cylinder head to see if it is cracked.

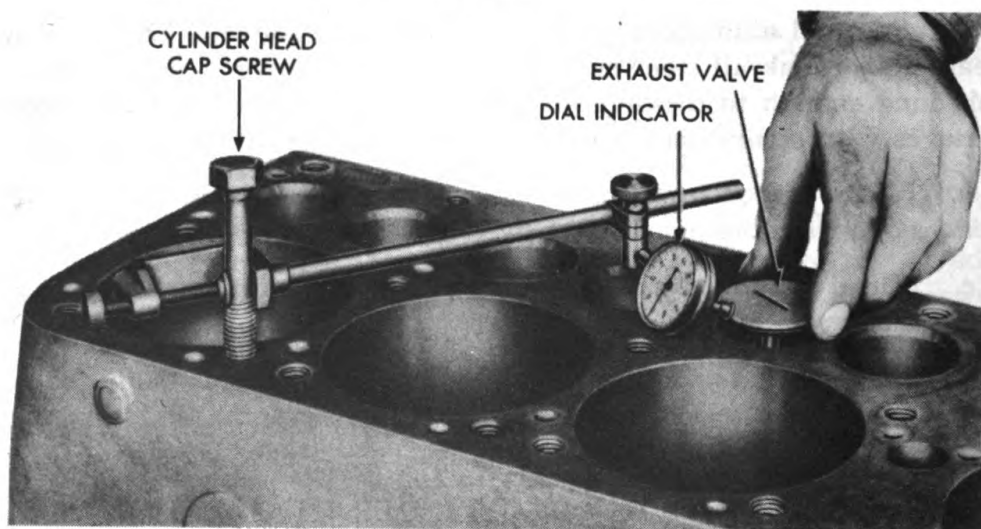
(2) Inspect machined face of cylinder head for nicks or scratches serious enough to allow water or compression leakage. Place straight-edge across machined surface of cylinder head and check for a warped head (fig. 121).

(3) Examine threads tapped in spark plug holes to see if they are burred or stripped.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 79555

Figure 121—Testing Cylinder Head for Warping

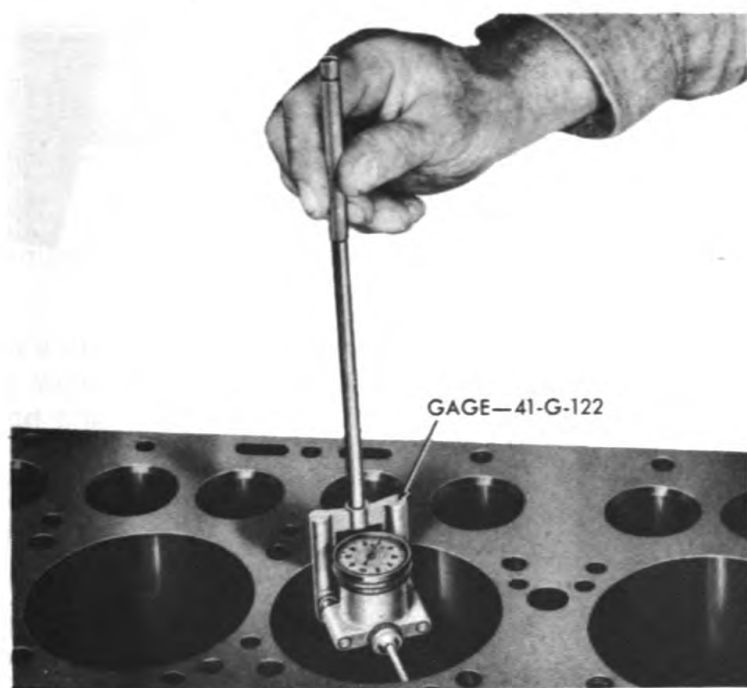
RA PD 79550

Figure 122—Measuring Valve to Valve Guide Clearance

(4) Inspect all cylinder head cap screws to see if they are bent, broken, burred, or stripped.

b. **Cylinder Block.** Inspect cylinder block for cracks especially between valve seats and cylinder.

ENGINE AND ACCESSORIES



RA PD 86680

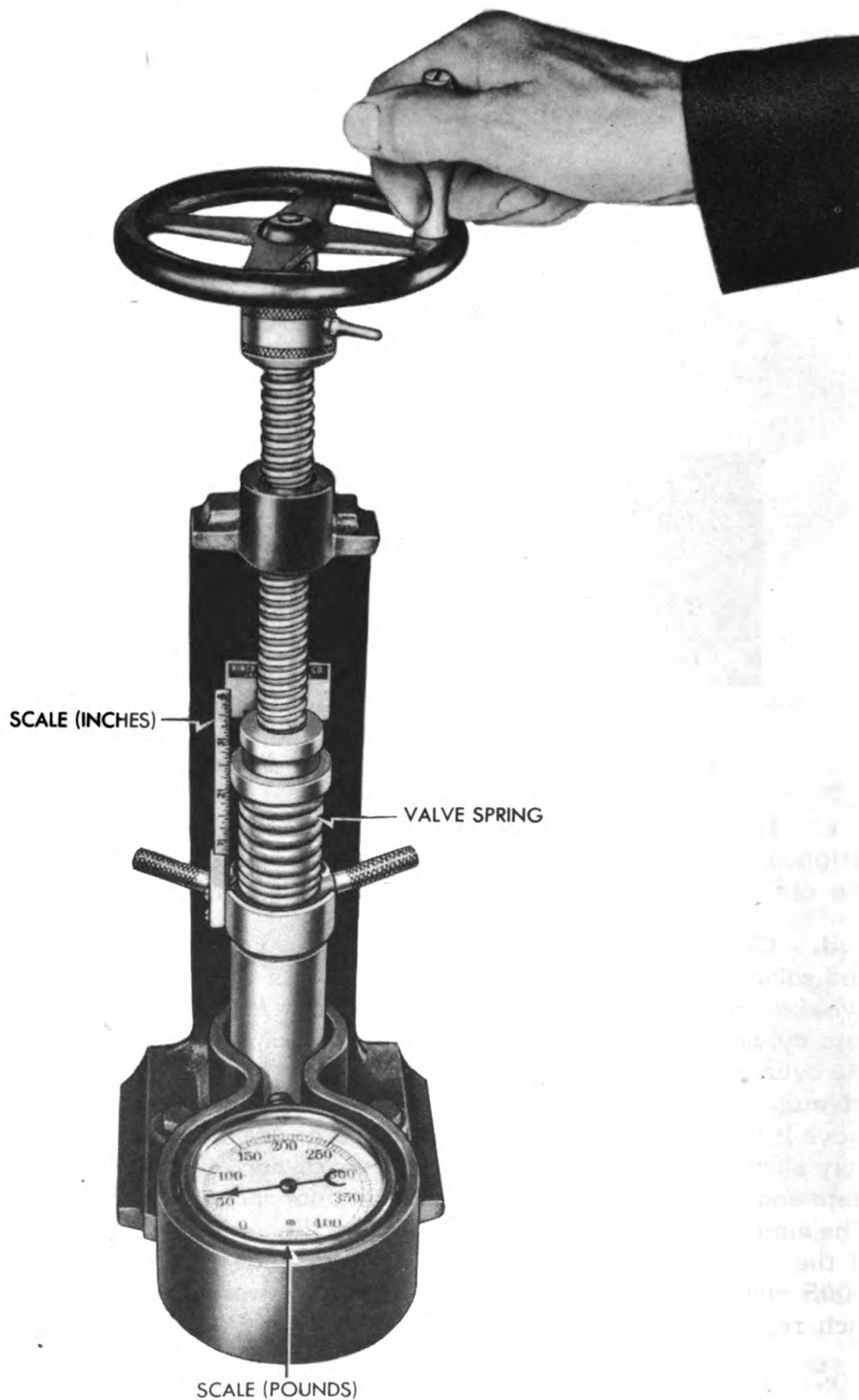
Figure 123—Checking Cylinder Bore Wear

c. Inspect all studs to see if they are bent, broken, burred, or stripped. Test cylinders for excessive taper and out-of-round with the dial indicator.

d. Clean the interior of the valve stem guide with a wire brush and solvent. Place the valve in the guide with the head of the valve five-sixteenths inch above the cylinder block. Attach a dial indicator to a cylinder head cap screw installed in a convenient screw hole in the cylinder block and adjust the plunger of the indicator against the edge of the valve head. Hold the valve so that it will not turn, and move it toward and away from the indicator and note the amount of play shown on the dial (fig. 122). The clearance between the valve stem and guide will be one-half of the amount shown on the indicator. The amount of wear in the guide would be the clearance less the wear of the valve stem. If an intake valve stem guide is worn more than 0.005 inch, or an exhaust valve stem guide is worn more than 0.007 inch, replace the guide.

e. Slide idler shaft into idler shaft bearing and test side play. If side play is more than barely perceptible, bearing is worn.

f. Slide camshaft into position in camshaft bearing. Measure



RA PD 79554

Figure 124—Testing Valve Spring Tension

ENGINE AND ACCESSORIES

clearances between bearings and journals with a feeler gage. Clearances in excess of 0.003 inch indicates worn bearings.

g. Notice condition of all threads tapped in stud and screw holes to see if they are burred or stripped.

h. Inspect all expansion plugs for looseness or leakage. Discoloration around the plug indicates leakage.

i. Examine valve seats to see if they are pitted, burned, or eccentric.

j. Run a dial indicator up, down, and around each cylinder. Note if readings vary as much as 0.003 to 0.005 inch, indicating taper or out-of-round (fig. 123).

63. VALVES AND VALVE OPERATING MECHANISM INSPECTION.

a. Inspect Valves.

(1) Examine valve faces to see if they are warped, pitted, cracked, or burned.

(2) Examine valve stems to see if they are bent or scored. Insert stems into guides and test side play. Presence of more than barely perceptible side play indicates wear.

(3) Examine valve springs, spring seats, and spring seat pins to see if any of them are bent, broken, or noticeably worn. Measure free length of springs. The measurement should be $3\frac{1}{16}$ inches. Test tension of springs to see if they are within the allowable limits of 47 to 53 pounds at $2\frac{3}{4}$ inches (fig. 124).

b. Inspect Valve Tappets.

(1) Examine faces of valve tappets for evidences of scoring.

(2) Examine valve tappet adjusting screws and lock nuts to see if they are bent, broken, burred, or scored.

(3) Examine female threads in valve tappet stem to see if they are burred or stripped.

(4) Insert tappets into their respective holes in clusters and test side play. More than a barely perceptible side play indicates a worn tappet or cluster.

(5) Examine valve tappet cluster to see if the casting is cracked or broken.

(6) Inspect cluster cap screws and lock washers to see if they are bent, broken, or burred. Note condition of threads on screws.

c. Inspect Camshaft.

(1) Inspect cams and journals for score marks.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

- (2) Examine thrust washer to see if it is worn or scored.
- (3) Examine camshaft gear and oil pump drive gear to see if either gear has chipped, worn, or broken teeth.
- (4) Examine threads on front end of shaft to see if they are burred or otherwise damaged.
- (5) Examine keyway to see if it is burred or spread.
- (6) Examine key, washer, and nut to see if they are bent, broken, or burred. Note condition of threads in nut.

64. PISTON AND CONNECTING ROD INSPECTION.

a. Connecting Rod.

- (1) Examine connecting rod bearing for score marks, or broken, chipped, or burned metal.
- (2) Inspect threads on connecting rod cap bolts, nuts, and piston pin lock screw to see if they are burred or stripped.
- (3) Test assembled connecting rod and piston for bend and twist (par. 70 e).

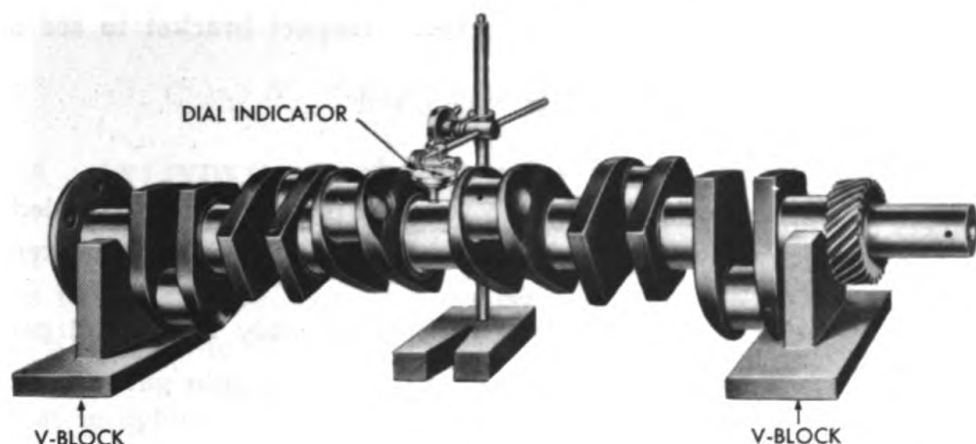
b. Piston.

- (1) Test fit of piston pin in piston pin bushing by attempting to rock the assembled connecting rod sidewise in the piston. Presence of side play indicates a worn piston or pin or both. **NOTE:** *Do not confuse endwise motion of pin in its bosses for side play.*
- (2) Carefully examine piston for score marks.
- (3) Inspect all piston rings to see if they are broken. Measure clearance of rings in piston ring groove with a feeler gage. A maximum of 0.0025 inch is permissible. Place piston rings in running position in cylinder. Measure clearance of end gap with a feeler gage. Safe maximum end gap is 0.020 inch.

65. WATER PUMP DRIVE INSPECTION.

- a. Inspect housing and sleeve to see if either of these castings is cracked.
- b. Examine all machined surfaces to see if any are burred or scored. Inspect teeth of all gears to see if they are pitted, nicked, chipped, or noticeably worn.
- c. Slide shaft into bushing and measure clearance with a feeler gage. A maximum of 0.002-inch side play is permissible.
- d. Examine key, washers, and nuts to see if they are bent, broken, scored, burred or noticeably worn. Note condition of threads on threaded parts.

ENGINE AND ACCESSORIES



RA PD 79563

Figure 125—Checking Crankshaft for Run-out

66. CRANKSHAFT AND CRANKSHAFT BEARING INSPECTION.

a. Crankshaft.

- (1) Examine teeth of crankshaft gear to see if they are worn or broken.
- (2) Examine bearing journals for evidence of scoring or burning.
- (3) Blow compressed air through oil passages to test for obstructions.
- (4) Measure diameter of each bearing journal at intervals with a micrometer. If sides of any journal varies more than 0.003 inch, the journal is seriously out-of-round.

(5) Revolve crankshaft in a lathe or V-block. Place a dial indicator against center main bearing journal (fig. 125). If readings show more than 0.002-inch run-out as crankshaft rotates, crankshaft is bent. **NOTE:** *This test can not be made if crankshaft has out-of-round journals (step (4), above).*

b. Crankshaft Bearings.

- (1) Examine bearings to see if they are scored, burned, or broken.
- (2) Inspect main bearing screws, caps, and shims to see if they are bent, broken, chipped, or burred. Note condition of threads on screw.

67. REMAINING ENGINE COMPONENTS, INSPECTION.

a. **Fan Drive Pulley.** Examine pulley and pin to see if they are broken or noticeably worn.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

b. Engine Front Support Bracket. Inspect bracket to see if it is cracked.

c. Oil Pan.

- (1) Examine oil pan for dents or cracks.
- (2) Examine strainer screen to see if it is bent, torn, or fouled.
- (3) Inspect screws and washers to see if they are bent, broken, or have damaged threads.
- (4) Inspect threads on oil drain pipe assembly and in oil pan strainer drain pipe opening.

d. Gear Cover.

- (1) Inspect gear cover to see if it is broken or if machined surfaces are nicked or burred.
- (2) Examine oil seals to see if they are worn or otherwise damaged.
- (3) Examine thrust plug, pins, plate, and shims to see if any of them are broken, bent, burred, nicked, or noticeably worn.
- (4) Inspect all screws, washers, and nuts to see if they are bent, broken, burred or stripped.

e. Inspect Idler Shaft Assembly.

- (1) Examine teeth of gear to see if they are nicked, chipped, pitted, or noticeably worn.
- (2) Inspect keyway in shaft and gear to see if they are spread.
- (3) Inspect thrust washer for wear.
- (4) Inspect shaft to see if it is scored.
- (5) Test fit of shaft in bushing. Noticeable side play indicates a worn bushing.

f. Inspect Flywheel.

- (1) Examine flywheel to see if it is cracked.
- (2) Test fit of dowel pins in pinholes. They should be a drive fit.
- (3) Examine threads in the eight a-c generator front fan attaching screw holes to see if they are burred or stripped.
- (4) Inspect teeth of ring gear to see if they are chipped, broken, or worn.

g. Bell Housing.

- (1) Inspect bell housing to see if it is cracked or broken.
- (2) Note condition of threads in all tapped holes.
- (3) Inspect all cap screws and lock washers to see if they are bent, broken, or stripped.

ENGINE AND ACCESSORIES**Section XI****ENGINE REPAIR****68. CYLINDER BLOCK AND CYLINDER HEAD REPAIRS.**

a. **Cracked Cylinder Block or Head.** Replace broken castings. In event a new part is unavailable, a casting cracked externally can be temporarily repaired, usually by welding.

b. **Leaking Expansion Plugs.** Drive a sharp punch through the leaking plug and pry from cylinder block. Scrape all dirt from seat in cylinder block. Coat new plug with joint-and-thread cement compound and drive to seat with soft block and hammer.

c. **Damaged Female Threads.** Remove burs with a thread tap. Correct stripped threads by filling hole with metal by welding. Drill hole to correct size and cut new threads with a thread tap.

d. **Studs or Screws Twisted Off in Cylinder Block.** If broken above surface, remove broken part with a stud remover. If broken flush with or below surface, drill stump and remove with a screw extractor.

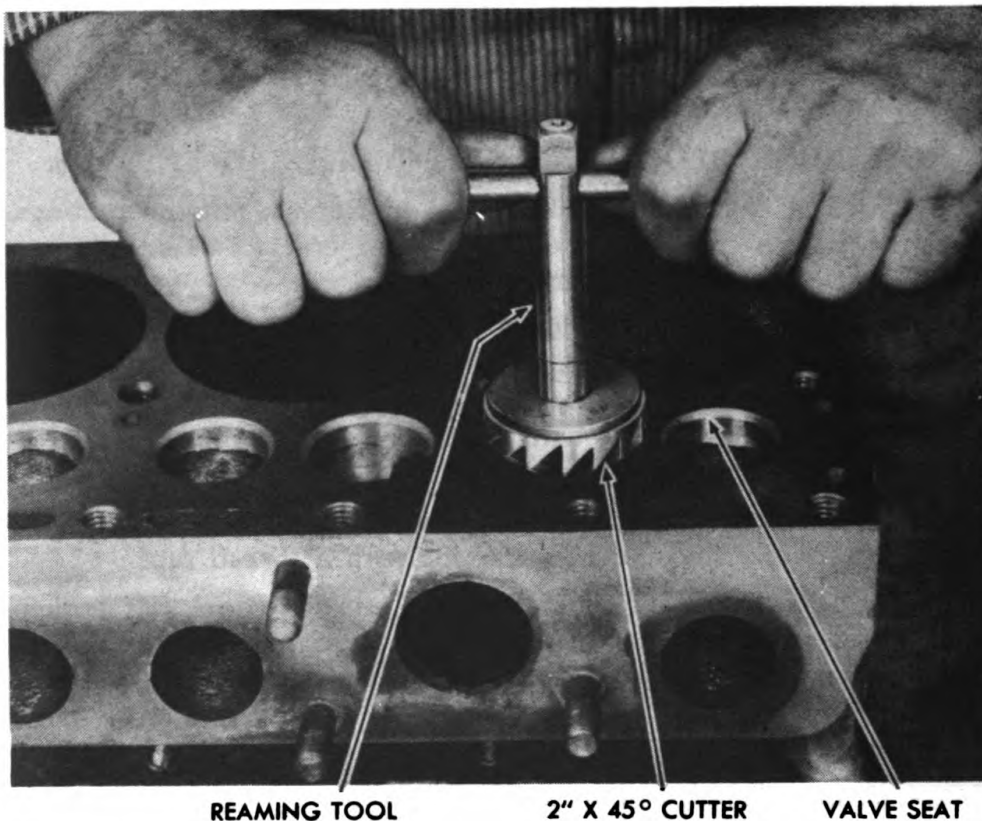
e. **Machined Surface Nicked or Scratched Seriously.** Unless damage permits leakage of water, compression, or oil, no correction is necessary. If leakage is present, replace damaged part or true up surface on a milling machine. Take as light a cut as possible, especially when repairing machined surface of cylinder block or cylinder head. If necessary to take a deep cut, use two gaskets to keep from altering compression appreciably.

f. **Cylinder Walls Worn or Scored.**

(1) **GENERAL.** Damaged cylinder walls are normally repaired by reboring and then honing. Cylinders only slightly tapered, out-of-round, or scored can be corrected by honing alone. Cylinders worn 0.005 inch or more should be rebored before honing.

(2) **REBORING.** Clean surface of top of cylinder block with a mill file. Position boring bar over cylinder and secure it to cylinder block with cylinder head cap screws. Center bar over cylinder and adjust cutting tools to size the cylinder is to be cut. This depends upon the size piston is to be fitted (par. 70 d) and amount of wear or depth of score marks. Start boring-bar motor and engage cutting tool. Stop motor as soon as cutting tool has cut the entire length of the cylinder bore. Return cutting tool to top of cylinder block and detach boring bar from cylinder block. Similarly rebore remaining five cylinders.

(3) **HONING.** Two types of hones are in common use—wet and dry. Each consists of a grinding tool which is revolved in the cylinder



RA PD 8057

Figure 126—Reaming a Valve Seat

by an electric motor. In a wet hone, cylinder wall is lubricated with Diesel fuel oil during the operation. No lubricant is used for a dry hone, but vacuum dust collecting equipment is set up under cylinder block. Place hone in position in cylinder and adjust rough cutting stones to cylinder size. Start hone motor and move hone slowly up and down as it revolves in cylinder. Hone high spots first. Then hone up and down full length of bore. Remove hone and install polishing stones and hone until piston fits with proper clearance (par. 70 d).

g. Valve Guides Worn. Using a pilot which fits the valve guide properly, drive valve guide from cylinder block. Position new valve guide on top of guide hole. Using proper fitting pilot, press guide into position with top of guide $2\frac{9}{32}$ inch below machine surface of block. Ream new valve guide with a straight fluted reamer to obtain 0.001- to 0.0015-inch clearance for the valve stem.

h. Valve Seats Pitted, Burned, Scored, or Eccentric. Refinish seat with a 45-degree valve seat reaming tool (fig. 126). Use seat tools with $\frac{3}{8}$ -inch diameter pilots. Continue process until each seat has an even width of $\frac{1}{8}$ to $\frac{5}{32}$ inch all the way around its circumference.

ENGINE AND ACCESSORIES



RA PD 79568

Figure 127—Refacing a Valve

If exhaust valve inserts are worn enough to cause seat tool to cut into metal of cylinder block, remove insert with a cold chisel and hammer. Pack new insert in dry ice for several minutes to shrink it. Remove insert from dry ice and quickly place it in position in cylinder block. If necessary, use a brass block and hammer to tap it to seat.

69. VALVES AND VALVE OPERATING MECHANISM REPAIR.

a. **General.** Replace valves if warped, cracked, burned, badly pitted, or if valve stems are worn. Replace worn or damaged valve spring, spring seats, and spring seat pins. Replace weak springs.

b. **Refacing Valves.** Reface valves if slightly pitted or slightly scored. Set valve facing angle at 45 degrees.

c. **Reconditioning Valve Seats.** Refer to paragraph 68 h.

d. **Lapping Valves.** After resurfacing valve seats and refacing valve, lap valves to seat as follows:

(1) Spread fine valve-grinding compound sparingly on face of valve. Insert valve through a light coil spring just long enough to hold valve clear of cylinder block.

(2) Place valve stem into its guide. Force valve down on its seat and rotate valve back and forth several times.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(3) Remove valve from cylinder block and remove coil spring from valve stem. Wash valve, valve seat, and valve guide with dry-cleaning solvent. Inspect valve face and valve seat to see if both have a bright polished appearance.

(4) Similarly lap other valves and test valve seat (subpar. e, below).

e. **Testing Valve Seat.** Place pencil marks at intervals around face of valve and insert valve into its guide. Press valve down to seat and turn valve a half turn. Remove valve and inspect face. If all pencil marks are rubbed out, fit is satisfactory. If pencil marks remain, repeat lapping and testing operation until satisfactory fit is obtained.

f. **Repairing Valve Tappets.** Smooth tappet faces which are lightly scored with a honing stone.

g. **Repair Camshaft.** Replace camshaft if cam faces are badly scored; if oil pump drive gear is chipped or worn, or if camshaft is sprung; or if bearing journals are scored. Replace camshaft gear if nicked or worn. Hone light score marks from cam faces with a stone.

70. PISTON AND CONNECTING ROD REPAIRS.

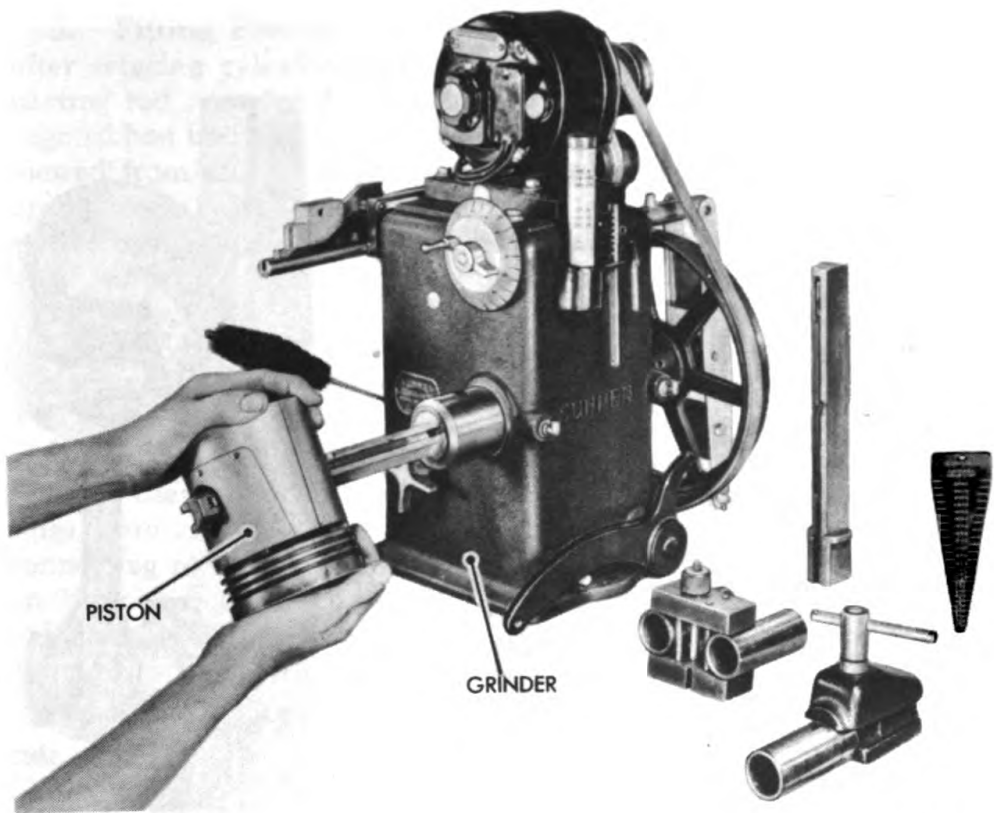
a. **General.** Replace connecting rod bearings if scored, broken, chipped, burned, or worn. Replace all damaged connecting rod cap bolts, nuts, piston pin lock screws, and washers. Replace worn piston rings. Replace scored, worn, or out-of-round pistons. Install oversize pistons whenever cylinder walls are resurfaced.

b. Fitting Piston Rings.

(1) Installation of piston rings will correct oil pumping and loss of compression past piston, provided the piston and cylinder walls are not damaged or worn excessively. If cylinder wall wear exceeds 0.005 inch, reface cylinder walls and fit oversize pistons. If cylinder wall wear is 0.003 to 0.005 inch, install oversize piston rings. If cylinder wall is less than 0.003 inch, install standard size piston rings. Measure cylinder wall with a dial indicator to determine the amount of wear. Inspect tops of cylinder bores. If walls are worn, an unworn portion at the top of the cylinder will appear as a narrow ridge. Remove ridge with a ridge remover.

(2) Slip piston ring into cylinder in running position. Measure end gap with a feeler gage. If end gap exceeds 0.020, use an oversize ring. If end gap is less than 0.015 inch, file ends of ring on a mill file secured on holding fixture to obtain that clearance. Fit each ring to the piston in which it is to be used.

ENGINE AND ACCESSORIES



RA PD 11968

Figure 128—Honing a Piston Pin Boss

(3) Examine ring grooves in each piston. Remove carbon with a ring groove cleaner or a portion of a broken piston ring. Carefully remove burs with a fine mill file. Clean carbon from oil return hole in oil ring groove.

(4) Install rings in proper grooves in pistons: oil ring (slotted ring) belongs in bottom groove of each piston, and compression rings (rings without slots) go in three upper grooves in each piston. Measure clearance of each ring in its groove between edge of ring and piston. Proper clearance is 0.001 to 0.0025 inch. If clearance is under 0.001 inch, remove ring and lap it on crocus cloth, shellacked to a flat surface, until proper clearance is obtained. If clearance exceeds 0.0025 inch, use a new piston ring, piston, or both.

c. **Fitting Piston Pins.** Attempt to insert piston pin into its bearing surfaces in piston. If impossible to insert piston pin, take a light cut from piston pin boss with a hone (fig. 128) and again attempt to insert pin. Repeat the operation until light push is obtained. If pin fits too loosely, replace piston.

CONNECTING ROD
ALINING FIXTURE

SURFACE PLATE

V-BLOCK

PISTON

CONNECTING
ROD

CHECKING FOR TWIST

CHECKING FOR BEND

RA PD 78614

Figure 129—Connecting Rod Alinement Tests

ENGINE AND ACCESSORIES

d. **Fitting Pistons.** Oversize pistons must be fitted to cylinder after refacing cylinder walls. Pistons are fitted with rings and connecting rod removed from piston. Insert end of a 0.0025-inch feeler gage ribbon into top of cylinder on thrust side (right-hand side when viewed from rear of engine) of cylinder. Push piston into cylinder, upside down, with feeler gage between cylinder wall and piston. Be sure piston is turned so piston pin bosses determine a line parallel with centerline of crankshaft. Pull on protruding end of feeler gage ribbon. It should pull out with a slight pull. If it binds, hone cylinder wall to provide additional clearance. If it pulls out without resistance, replace piston with a larger oversize and repeat operation.

e. **Alining Connecting Rods** (fig. 129).

(1) Clamp assembled connecting rod and piston, without piston rings, onto a connecting rod alining fixture. With piston upright on connecting rod, hold V-block against piston and surface plate. If pins on V-block both touch surface plate, connecting rod is straight. If only one pin touches surface plate, connecting rod is bent. Slide a bending rod onto bent connecting rod and bend until straight.

(2) After straightening connecting rod, cock the piston to one side as far as it will go. Place V-block against piston and surface plate. Slowly tip piston as far as it will go in opposite direction from which it was cocked. Observe pins of V-block on surface plate. If neither pin lifts from surface plate as piston is tipped, connecting rod is free of twist. If one of the pins lifts from the surface plate, connecting rod is twisted. Straighten twisted connecting rod with bending bar.

71. MISCELLANEOUS ENGINE REPAIRS.

a. **General.** Replace all gaskets.

b. **Oil Pan.** Bump dents from oil pan. Clean carbon from oil strainer screen with solvent and a wire brush. Clean up damaged threads with a thread tap. Replace oil pan if broken. In absence of a suitable replacement part, make temporary repairs by brazing.

c. **Flywheel.** Replace flywheel if cracked or broken. Replace dowel pins with oversized dowel if holes in flywheel are too large. Clean up threads in screw holes with a thread tap. Replace flywheel if threads are stripped or if ring gear teeth are broken or worn.

d. **Crankshaft.** If crankshaft gear is worn or broken, press it from crankshaft and press on new gear.

e. **Main Bearings.** Replace main bearings if scored, chipped, broken, burned, or worn. Replace shims if bent or torn. Replace caps if broken. Replace screws if broken or if threads are damaged.

Section XII

ENGINE ASSEMBLY AND INSTALLATION**72. ASSEMBLY.****a. Install Idler Gear Onto Shaft (fig. 130).**

- (1) Tap key to seat in keyway in shaft.
- (2) Aline keyway in gear with key in shaft and press gear as far as it will go into shaft.

b. Install Gear on Camshaft (fig. 131).

- (1) Tap key to seat in keyway at front end of shaft. Slide thrust washer onto shaft.
- (2) Turn gear so timing mark (prick-punch mark) is on side of gear away from camshaft. Aline keyway in gear with key in shaft and press gear to seat on shaft.
- (3) Install washer and nut on camshaft.

c. Assemble Gear Cover (fig. 132).

- (1) Screw lock nut onto camshaft thrust screw. Start screw into its hole from outside of gear cover.
- (2) Place plug in position with pinholes alined in idler gear thrust plate. Tap the two pins into pinholes.
- (3) Position approximate number of shims (about 18) on plate and install plate on gear cover with the three lock washers and screws. Final shim adjustment will be made after gear cover installation.
- (4) Press water pump drive shaft oil seal into its seat in gear cover. Be sure leather lip points toward inside of cover.
- (5) Slide crankshaft oil seal into position in its seat on under side. Be sure leather lips point toward inside of cover.

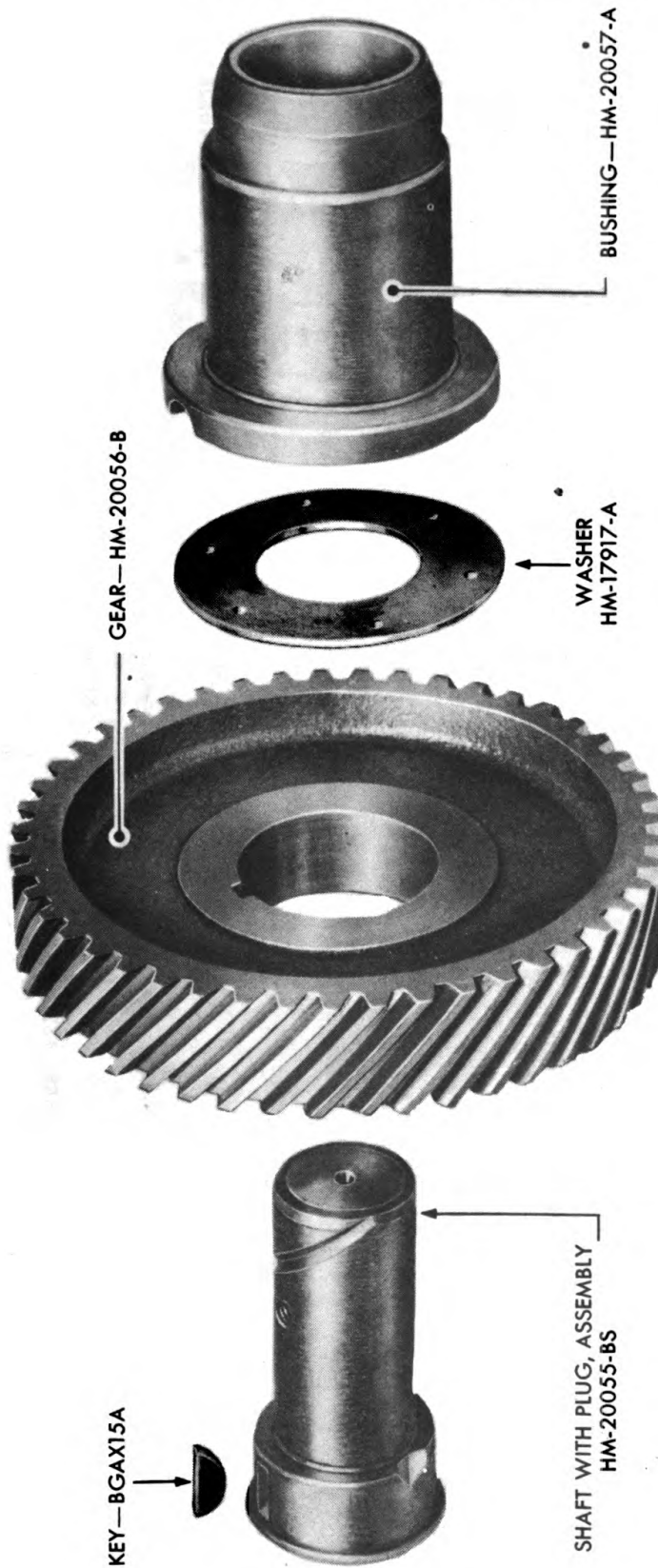
d. Assemble Connecting Rod and Piston Assembly (fig. 133).

- (1) Position rod within piston so that cap screw securing connecting rod to piston pin will be opposite the split on the piston skirt. Insert previously fitted piston pin through piston and rod. Turn pin to aline slot with screw hole in rod. Install piston pin screw and lock washer. Tighten screw securely.
- (2) Using a piston ring expander, slide previously fitted oil ring over top of piston into lower ring groove of piston. In same manner, install three previously fitted compression rings in the upper grooves of piston.

e. Assemble Oil Pump. Refer to paragraph 47 e.

ENGINE AND ACCESSORIES

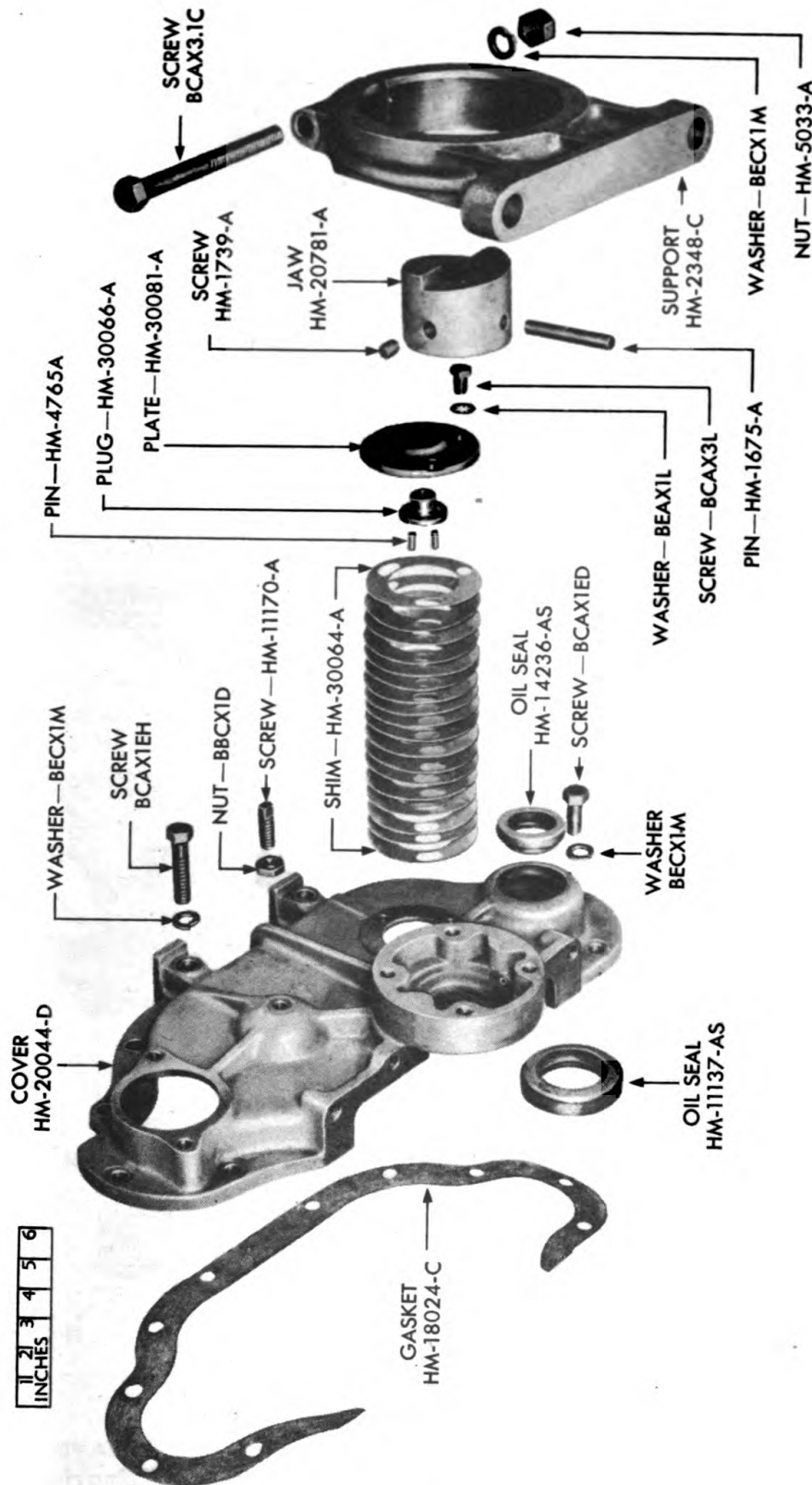
RA PD 46670



INCHES	1	2	3	4	5	6
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Figure 130—Idler Shaft and Gear Disassembled

ENGINE AND ACCESSORIES



RA PD 46440

Figure 132—Gear Cover Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18

- A—RING—HM-3818-A
 B—RING—HM-3917-A
 C—PISTON—HM-18709-C
 D—PIN—HM-18876-B
 E—WASHER—BEAX2A
 F—SCREW—HM-11756-A
 G—ROD—HM-21290-C
 H—BOLT—HM-21055-A
 J—SHIM—HM-35068-A
 K—BEARING—HM-20198-B
 L—WASHER—HM-19680-A
 M—PIN—HM-1707-A
 N—BEARING—HM-20074-B
 P—BOLT—HM-7104-A
 Q—SHIM—HM-35206-A
 R—CAP—HM-20094-B
 S—SCREW—HM-20097-A
 T—BEARING—HM-20075-B
 U—SHIM—HM-35208-A
 V—CAP—HM-20095-B
 W—SCREW—HM-20096-A
 X—BEARING—HM-20073-B
 Y—SHIM—HM-35207-A
 Z—CAP—HM-20093-B
 AA—NUT—BBFX1DA
 BB—PIN—BFAX1DG
 CC—CAP—HM-21291-C
 DD—BEARING—HM-20072-B
 EE—SHIM—HM-35205-A
 FF—CAP—HM-20092-B
 GG—CRANKSHAFT—HM-19136-E
 HH—GEAR—HM-18039-B

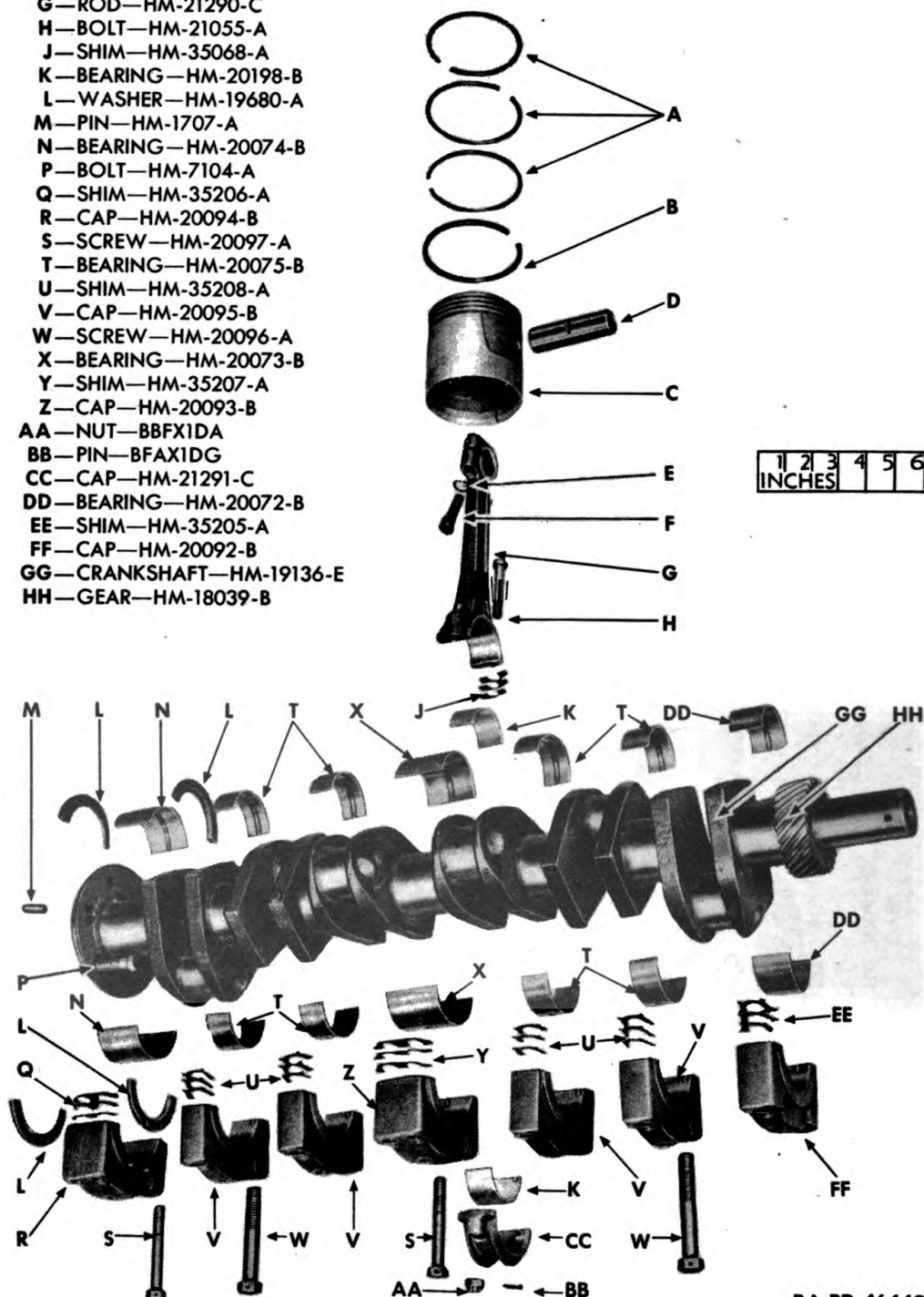


Figure 133—Piston, Connecting Rod, Crankshaft, and Bearing Arrangement

RA PD 46448

ENGINE AND ACCESSORIES

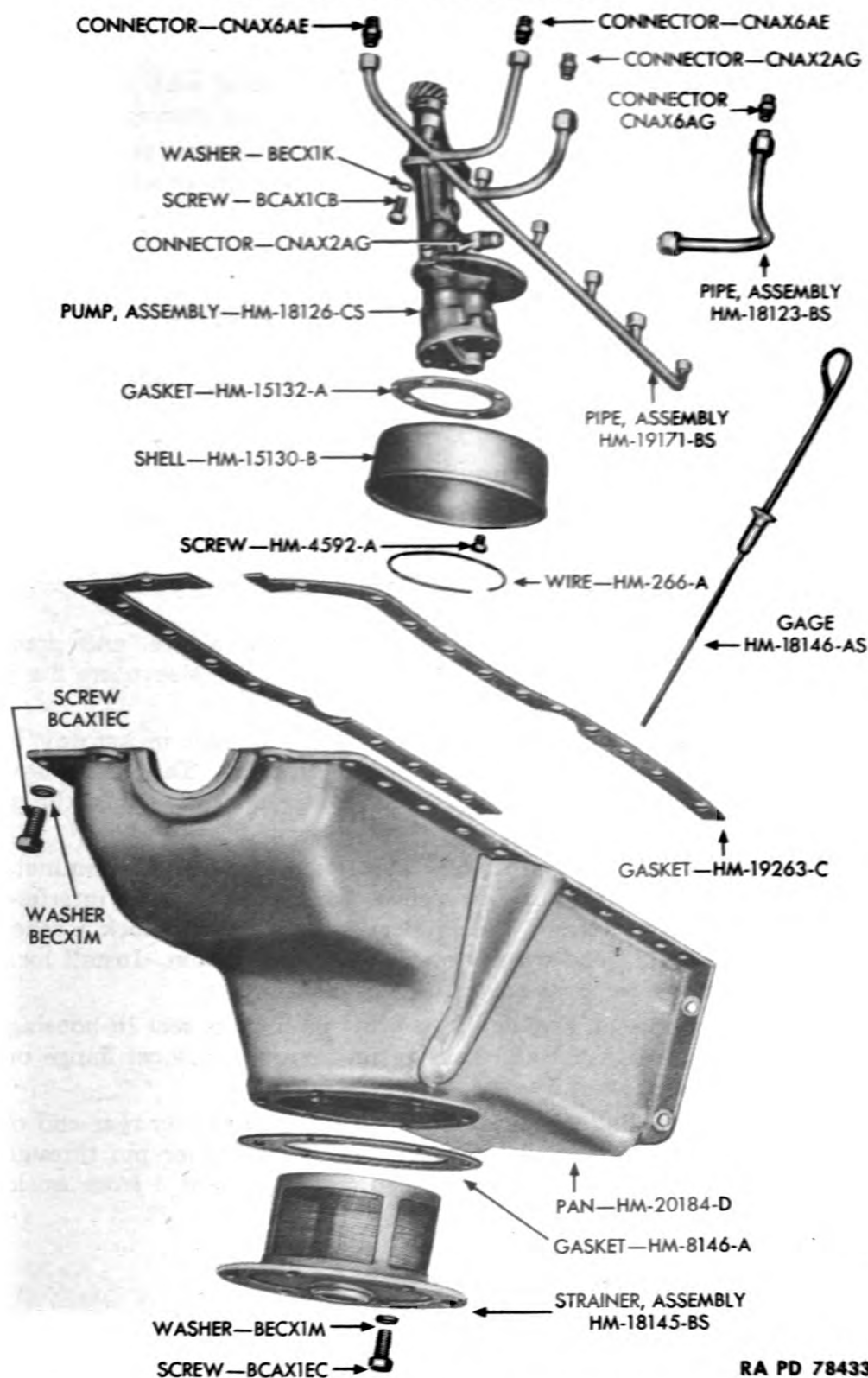


Figure 134—Oil Pan, Oil Pump, and Oil Pipe Arrangement

ORDNANCE MAINTENANCE—GENERATING UNIT M18

f. Assemble Oil Pan (fig. 134).

(1) Coat male threads of oil drain pipe elbow with white lead pigment and screw tightly into drain hole in oil pan strainer.

(2) Position strainer gasket and strainer on oil pan (elbow pointing to left). Install the six lock washers and cap screws which attach strainer to oil pan.

g. Assemble Valve Tappet Clusters (fig. 131).

(1) Screw lock nut onto each valve tappet adjusting screw. Screw each screw into top of a tappet.

(2) Insert tappets through tappet holes from under side of clusters.

h. Assemble Water Pump Drive (fig. 135).

(1) Tap key into position in keyway in drive shaft gear seat on front end of shaft. Aline keyway in gear with key on shaft. Press gear to seat on shaft. Press oil thrower, dished side out, onto front end of shaft until thrower seats against gear.

(2) Aline oilholes and slots in bushing and sleeve, and press bushing into sleeve. Press until ends of bushing and sleeve are flush. Slide sleeve, small end first, onto rear end of shaft.

(3) Tap distributor drive worm gear key to seat in keyway in shaft. Slide thrust washer onto rear end of shaft. Tap distributor drive gear, collar first, to seat on shaft over key and up against thrust washer.

(4) Install gear retaining nut. Tighten nut enough to eliminate noticeable end play of shaft in sleeve, but not enough to interfere with free rotation of shaft within sleeve. Slide special lock washer onto end of shaft. Bend washer over one of flats of nut. Install lock nut and bend washer over one of flats of lock nut.

(5) Press oil seal, leather lip pointing in, into its seat in housing. Slide new housing gasket and housing into position against flange on sleeve over end of shaft.

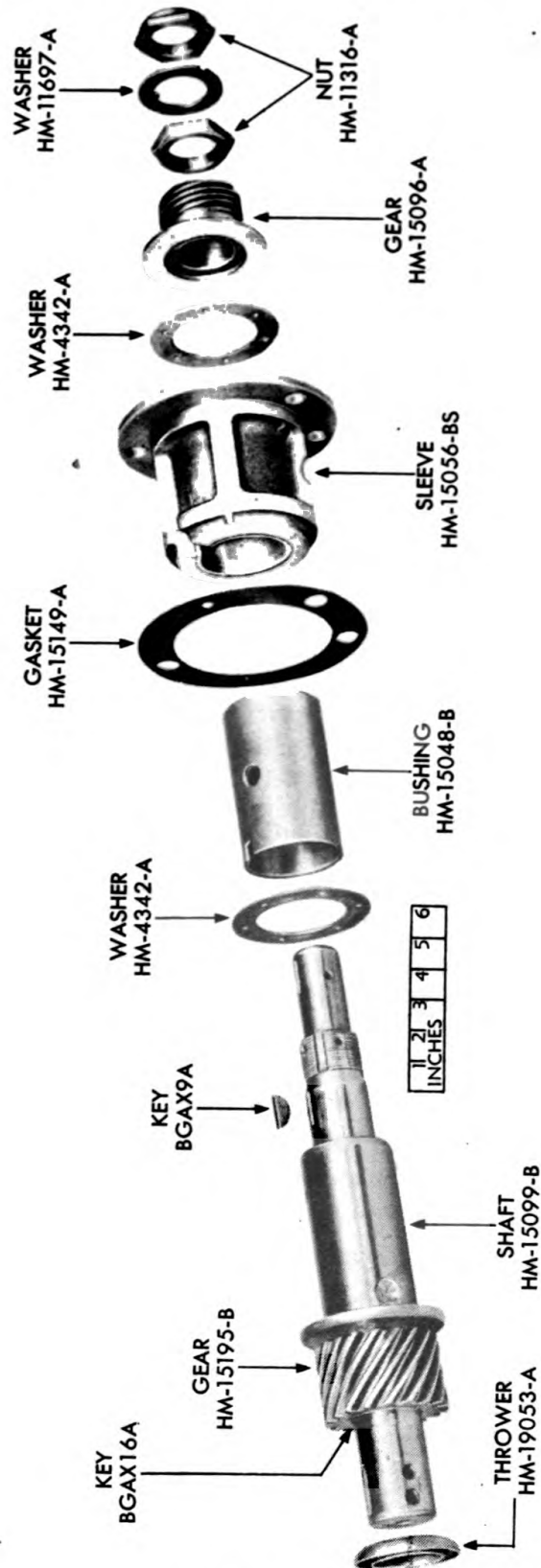
(6) Tap coupling sprocket key to seat in keyway on rear end of shaft. Press sprocket onto shaft over key. Drive taper pin through pinhole in sprocket and shaft, and peen pin to prevent it from working out.

i. Install Crankshaft (fig. 133).

(1) Place upper bearing shells in position in upper bearings, each shell in bearing from which removed if old bearings are reused. Coat bearing surface of each bearing with engine oil.

(2) Set crankshaft in position in upper bearings.

ENGINE AND ACCESSORIES



RA PD 46438

Figure 135—Water Pump Drive Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(3) Fit thrust washer halves into place between rear main bearing and crankshaft flange.

(4) Place rear main bearing shell and cap in position. Add or remove shims until crankshaft can be just turned with considerable effort. Then add a 0.002- to 0.003-inch shim to each side to obtain proper clearance. Tighten cap screw to 70 foot-pounds tension. Run No. 12 wire through holes of each pair of cap screw heads. Crimp wire together to lock screws.

(5) Repeat procedure of step (4), above, to install center main bearing shell and cap.

(6) Install front bearing cap (step (4), above). Proper wrench tension is 105 foot-pounds.

(7) Install rear intermediate bearing (step (4), above). Wrench tension is 105 foot-pounds.

(8) Install front intermediate bearing (step (4), above). Wrench tension is 105 foot-pounds.

j. Install Bell Housing and Flywheel (fig. 113).

(1) Position bell housing gasket and bell housing on rear end of cylinder block. Install the six lock washers and cap screws (two inside housing, four outside) which attach bell housing to block. Tighten screws securely.

(2) Place flywheel on rear end of crankshaft with dowels in dowel holes. Flywheel will fit in only one position and it goes on easily when properly positioned. Install the four castellated nuts which attach flywheel. Place a wood block between crankshaft and cylinder block to keep crankshaft from turning. Draw up on nuts evenly to insure proper seating of the flywheel against the crankshaft. Tighten nuts securely and install a new cotter pin through each nut.

k. Install Camshaft and Time Engine (Valve Timing) (fig. 136).

(1) Carefully insert camshaft in camshaft bearings in cylinder block. Do not allow cams to drag on or hit bearings.

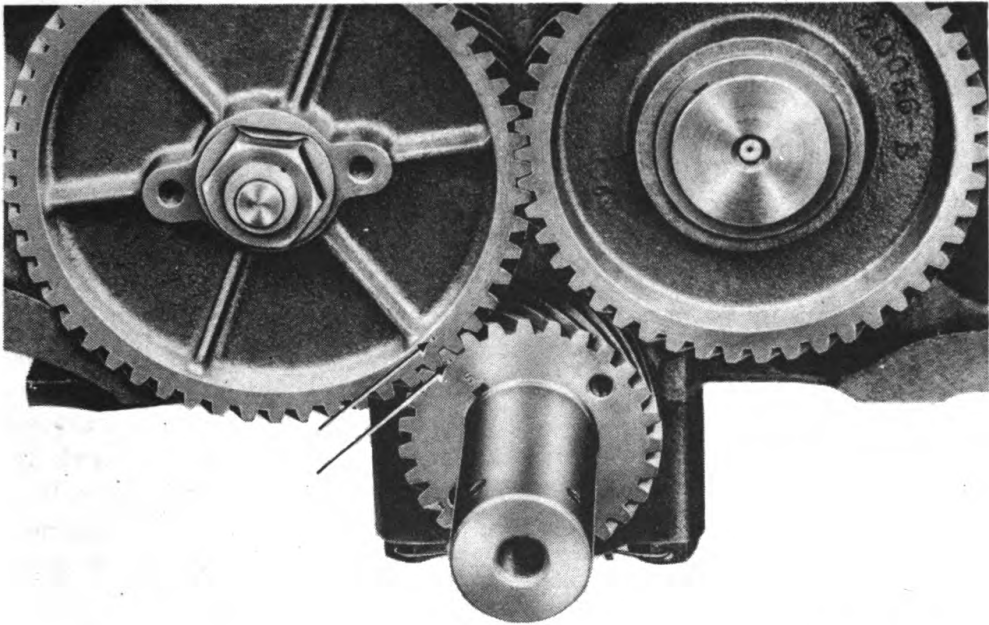
(2) Turn crankshaft and camshaft so timing marks (prick-punch marks) are adjacent, and mesh gears.

l. Install Idler Gear and Gear Cover (fig. 119).

(1) Oil idler shaft with engine oil. Slide thrust washer onto idler shaft and slide idler shaft into bushing to left of camshaft gear. Mesh idler gear with camshaft gear.

(2) Spread a film of engine oil over gears exposed on front of engine.

ENGINE AND ACCESSORIES



RA PD 78610

Figure 136—Crankshaft Gear and Camshaft Gear Timing Marks

(3) Check crankshaft oil seal to be sure it is installed in its seat on lower side of gear cover. Be sure internal and external leather lips point toward inside of cover.

(4) Position gear cover on front of cylinder block with oil seal around protruding end of crankshaft. Install the 10 lock washers and cap screws which attach cover to cylinder block. Place governor oil tube clip under head of top screw to left of center. Connect oil tube nut to fitting on left side of cylinder block adjacent to filter position.

(5) Tighten camshaft thrust screw until snug against end of camshaft. Back off screw one-quarter turn and tighten lock nut.

(6) Reaching through water pump drive hole, grasp idler gear. Test end play of idler shaft. It should be perceptible, but not excessive (0.003 to 0.010 inch). Add or remove shims from under thrust plug plate on outside of gear cover to secure proper adjustment.

m. Install Cranking Jaw and Front Engine Support (fig. 112).

(1) Aline pinholes in cranking jaw and front end of crankshaft. Drive jaw onto crankshaft. Drive pin into place through jaw and shaft. Install set screw which holds pin in position.

(2) Slide front engine support into place over collar on gear cover. Turn support so cap screw in support is horizontal and at top. Tighten cap screw securely. Tighten lock nut on cap screw.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

n. Install Connecting Rods (fig. 133).

- (1) Coat pistons and bearing surfaces with seasonal grade engine oil.
- (2) Compress rings on No. 1 piston with a piston ring compressor.
- (3) Turn piston so that the side marked "FRONT" is toward front of engine. Insert assembly, connecting rod first, into No. 1 cylinder. Tap top of piston with a wood block. Remove piston ring compressor from piston after rings enter cylinder.
- (4) Fit upper connecting rod bearing shell in place in connecting rod. Fit connecting rod over crankshaft. Insert connecting rod cap bolts through holes in base of rod from top. Place connecting rod bearing shell and cap in position on screws. Install shims calculated to carry proper clearance around cap bolt on side opposite camshaft. Tighten connecting rod castellated nuts to 63 foot-pounds pressure. Crank engine. Add or remove shims until engine can be just turned over with considerable force. Then add a 0.0015- to 0.002-inch shim to obtain required clearance. Tighten nuts to 63 foot-pounds pressure and install cotter pins.
- (5) Similarly install the five remaining pistons.

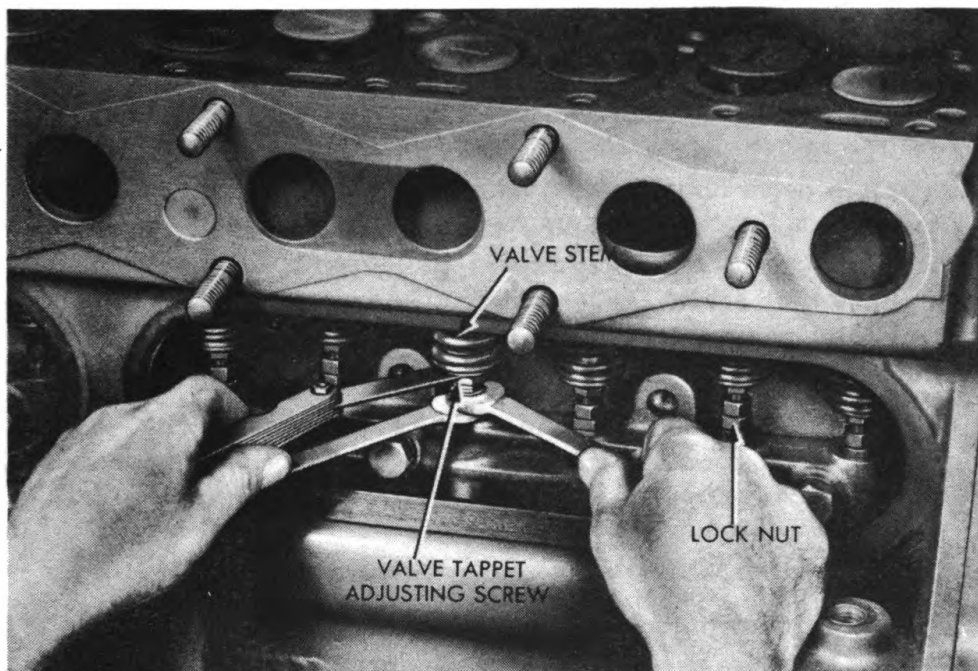
o. Install Oil Pipe, Oil Pump, and Oil Pan (fig. 134).

- (1) Place oil pipe in position with pipe ends against engine fittings. Tighten oil pipe sleeve nuts to fittings.
- (2) Place oil pump in position on cylinder block. Tightly install the four lock washers and cap screws which attach pump to cylinder block. Screw oil pipe sleeve nut onto fitting on pump.
- (3) Coat the two halves of the cylinder block to oil pan gasket with gasket cement and stick them in position on the machined surfaces on the lower edge of the cylinder block. Push oil pan against gasket and against bell housing gasket. Install the 29 lock washers and cap screws which attach oil pan to cylinder block and bell housing.

p. Install Valve Tappet Clusters and Valves (fig. 131).

- (1) Place tappet cluster with tappets in position in valve chamber on right side of cylinder block. Install the four lock washers and screws which attach cluster to block. Similarly install other cluster in other valve chamber.
- (2) Insert valve spring seats in loosely coiled end of valve springs and place spring and seats in position between top of valve chamber and tappets. Insert each valve stem into valve guide in which it was originally installed. Insert valve spring lifter between top of tappet cluster and spring seat. Compress spring and lock lifter in place. Insert pin in slot in valve stem. Release lifter tension on spring and remove lifter. Similarly install remaining valve spring seat pins.

ENGINE AND ACCESSORIES



RA PD 79565

Figure 137—Valve Adjustment

q. Adjust Valve Tappets (fig. 137). From front to rear of engine, exhaust valves are Nos. 1, 4, 5, 8, 9, and 12; intake valves are Nos. 2, 3, 6, 7, 10, and 11. To adjust valves on No. 1 cylinder, turn engine over with hand crank until intake valve of No. 6 cylinder begins to open. Loosen lock nut on valve tappet adjusting screw. Adjust screw so clearance between screwhead and valve stem is 0.010 for intake valve and 0.016 for exhaust valve (cold engine). Crank engine until No. 2 cylinder intake valve opens, and adjust valves in No. 5 cylinder. If No. 4 intake valve opens, adjust valves in No. 3 cylinder. When No. 1 intake valve opens, adjust valves in No. 6 cylinder. When No. 5 cylinder intake valve opens, adjust valves in No. 2 cylinder. When No. 3 intake cylinder opens, adjust valves in No. 4 cylinder. Valves will be reset to 0.006 intake, 0.010 exhaust (hot engine) after engine is installed and warmed up.

r. Install Cylinder Head (fig. 112).

(1) Place a new cylinder head gasket in position on cylinder block. Set cylinder head in position on gasket. Install cylinder head cap screw fingertight with spark plug wire tube in position under two of the screws.

(2) Tighten screw in rotation, a part turn at a time, beginning at the center of the head and working to the outside. Use a tension wrench and tighten to 60 foot-pounds when using copper asbestos gasket, or 75 foot-pounds when using steel asbestos gasket.

ORDNANCE MAINTENANCE—GENERATING UNIT M18**s. Install Water Pump Drive and Shaft Pulley (fig. 112).**

(1) Using new gasket, push water pump drive housing to flange on left side of engine. Rotate shaft as necessary to mesh gears.

(2) Install the three lock washers and cap screws which attach water pump drive housing to cylinder block.

(3) Tap water pump pulley key to seat in front end of water pump drive shaft. Aline keyway in pulley with key on shaft and press pulley onto shaft. Drive drift pin through pinhole in pulley and shaft. Install new cotter pin at each end of drive pin to hold it in position.

t. Install Oil Filler Pipe Adapter. Place adapter (fig. 112) in position on its boss on left side of cylinder block. Using a soft block, tap adapter to seat.

73. INSTALLATION OF ACCESSORIES.

a. Install distributor (par. 54 f).

b. Position oil filler pipe and breather assembly in oil pipe adapter. Tap pipe to seat within the adapter.

c. Using a new gasket, push governor in place on right front of cylinder block. Install the two lock washers and cap screws which hold governor to engine. Connect oil line to elbow on top of governor (fig. 13).

d. Install the following assemblies according to instructions in TM 9-617: both starting motors, ignition coil, spark plugs, battery charging generator, fuel pump, manifold, throttle body, carburetor, water pump, bypass, thermostat with housing, bayonet-type oil gage, fan and bracket, and fan belt.

74. INSTALLATION.

a. General. There are two alternatives for engine installation, depending upon alternative chosen for removal. The engine and generator assembly can be installed as a unit or engine can be installed by itself. Each method is given below.

b. Engine Installation.

(1) Hoist engine into position on frame (fig. 109).

(2) Attach engine to a-c generator (par. 86).

(3) Install the two bolts, lock washers, and nuts which attach front engine support (fig. 112) to frame and remove hoist from engine.

(4) Connect oil pressure gage line to fitting on base of oil filter (fig. 12).

ENGINE AND ACCESSORIES

(5) Insert temperature gage bulb into fitting on left rear corner of cylinder head and tighten bulb nut onto fitting (fig. 12).

(6) Screw oil drain pipe into elbow on under side of oil pan (fig. 116) and install drain plug. Use white lead pigment on threads of pipe and tighten pipe securely.

(7) Connect cable to terminal on each starting motor (figs. 12 and 13).

(8) Install muffler and exhaust tube.

(9) Connect terminal block to ignition coil wire to "IGN" terminal of ignition coil (fig. 12).

(10) Connect "CG" wire to "CG" terminal of two-charge regulator (fig. 13).

(11) Connect tank-to-valve gasoline line to valve at fuel pump (fig. 13).

(12) Position gasket between air intake elbow and carburetor and install lock washers and cap screws which attach elbow to carburetor. Connect choke control to air shutter lever on carburetor. Be sure to have control pushed in and air shutter open when connection is made. Connect throttle control to throttle lever on carburetor. Be sure to have throttle control pushed in and throttle valve open when connection is made (fig. 12).

(13) Install radiator base support, radiator (par. 28 f), hood, all four side panels, and all four doors.

(14) Fill crankcase with engine oil to "4/4" mark on bayonet gage.

(15) Fill cooling system with clean fresh water or antifreeze solution. Do not use salt water in cooling system.

c. Installation of Engine and Generator Assembly.

(1) Connect engine to generator (par. 86).

(2) Hoist engine and generator assembly into position on frame (fig. 106).

(3) Install the six bolts, lock washers, and nuts which attach engine and generator assembly to frame. Remove hoist from assembly.

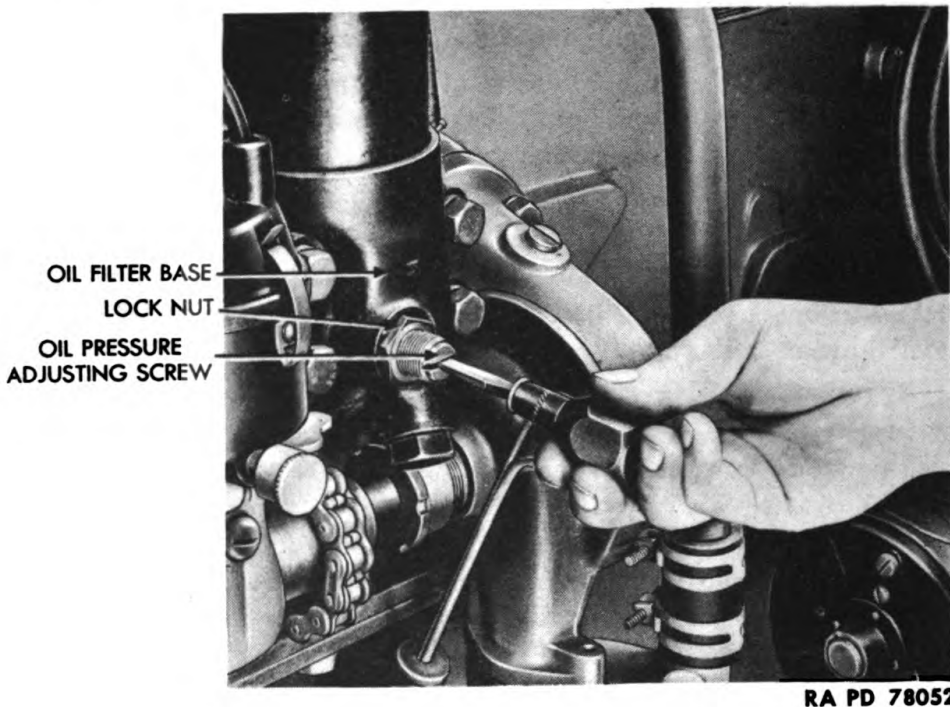
(4) Position rear fan cover on generator and install the lock washers and screws which attach cover to generator housing.

(5) Install muffler and exhaust tube.

(6) Apply white lead pigment to threads on oil drain pipe and tighten pipe securely into elbow on bottom of oil pan (fig. 116). Tighten drain plug into pipe.

(7) Install radiator (par. 28 f), center upright frame, rear upright frame, battery and tool box shelf, instrument panel (par. 96), hood, all four side panels, and all four doors.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78052

Figure 138—Oil Pressure Adjustment

(8) Fill crankcase with seasonal grade engine oil to "4/4" mark on gage.

(9) Fill cooling system with clean fresh water or antifreeze solution. Do not use salt water.

75. TESTS AND ADJUSTMENTS.**a. Before Starting Engine.**

(1) Check oil, coolant, and gasoline supplies. Make up any deficiencies.

(2) Open valve at each end of tank to pump gasoline line.

(3) Check cooling system for leaks. Repair all leaks.

(4) Check fuel system for gasoline leaks. Repair all leaks.

(5) Check engine for oil leaks. Repair all leaks.

(6) Examine ignition wires, battery charging generator circuit wires, and a-c generating system wires to be sure all connections are made and tight.

(7) Lubricate engine accessories.

(8) Hand-crank engine through a few revolutions. This will determine whether the engine is free, without causing damage. Repair any malfunction which this precaution might reveal.

ENGINE AND ACCESSORIES**b. After Starting Engine.**

(1) After starting engine and allowing it to run a few seconds, note reading of oil pressure gage. Turn engine off immediately if no oil pressure is indicated. Locate and correct the cause before starting engine.

(2) Listen for knocks or noises indicating malfunctioning of engine or accessories. Locate and correct the cause of any such noises.

(3) Inspect cooling system, engine, and fuel system to see if leakage of coolant, engine oil, or gasoline is in evidence. Repair all leaks.

(4) Inspect manifold exhaust tube and muffler for leakage of exhaust gases. Repair leaks.

(5) Add seasonal grade engine oil to "4/4" mark on gage to compensate for oil contained in oil filter, governor, and oil pipes.

(6) After engine has run for at least 15 minutes and is thoroughly warmed up, adjust oil pressure to 25-pound pressure at 1,200 revolutions per minute. This is done by turning the adjusting screw in the oil filter base (fig. 138). Tightening screw increases pressure.

(7) Adjust valve tappets. Proper clearance is 0.006 inch for intake and 0.010 inch for exhaust valves with engine thoroughly warmed up. Detailed procedure for valve adjustment is given in paragraph 72 q.

(8) After engine has had from 5 to 10 hours service, check tightness of mounting bolts, cylinder head screws, hose clamp screws, accessory mounting screws, and electrical connections.

Section XIII**CONSOLIDATED ENGINE SERVICE DATA****76. FITS AND CLEARANCES.****a. Clearances.**

Main bearings	0.002 to 0.003 in.
Connecting rod bearings	0.0015 to 0.002 in.
Camshaft bearings	0.0015 to 0.0025 in.
Idler bearing clearance	0.001 to 0.0025 in.
Water pump drive shaft bearings.....	0.0015 to 0.0025 in.
Valve tappets (engine hot):	
Intake	0.006 in.
Exhaust	0.010 in.
Piston to cylinder wall.....	0.003 to 0.0035 in.
Piston pin to piston	0.0002 to 0.0003 in.
Piston rings:	
End gap	0.015 to 0.020 in.
Ring to piston (in groove).....	0.001 to 0.0025 in.
Bell housing on chamber.....	0.012 to 0.025 in.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

Gear cover clearance around water pump drive

shaft 0.006 to 0.015 in.

Oil pan clearance around crankshaft 0.008 to 0.015 in.

Carburetor:

Metering well to bowl (max) 0.005 in.

Float bottom to cover bottom $1\frac{7}{32}$ to $1\frac{9}{32}$ in.

b. Gap Settings.

Distributor points 0.020 in.

Spark plugs 0.025 in.

Two-charge regulator:

Circuit breaker armature 0.010 to 0.030 in.

Circuit breaker contact 0.015 to 0.045 in.

Voltage regulator armature 0.044 to 0.046 in.

Voltage regulator contact 0.005 in. min

c. Gear Backlash.

Water pump drive gear to idler 0.002 to 0.004 in.

Idler gear to cam gear 0.001 to 0.002 in.

Cam gear to crankshaft gear 0.000 to 0.001 in.

Oil pump gear to cam gear 0.008 to 0.010 in.

d. End Thrust.

Crankshaft 0.003 to 0.005 in.

Water pump drive shaft 0.001 to 0.003 in.

77. WRENCH TENSIONS.

	Foot-pounds
Main bearing cap screws, rear and center	70
Main bearing cap screws, front and intermediate	105
Connecting rod bearing cap bolt nuts	63
Cylinder head cap screws:	
Copper asbestos gasket	60
Steel asbestos gasket	75

78. MISCELLANEOUS DATA.

Distributor breaker arm spring tension 12 to 17 oz

Firing order 1-5-3-6-2-4

Valve seats:

Angle 45 deg

Width $\frac{1}{8}$ to $\frac{5}{32}$ in.

Diameter, intake $1\frac{13}{16}$ in.

Diameter, exhaust $1\frac{11}{16}$ in.

Valve timings:

Intake opens 1 deg 52 min past dead center

Intake closes 46 deg 52½ min past bottom center

Exhaust opens 43 deg 7½ min before bottom center

Exhaust closes 1 deg 52½ min past dead center

CHAPTER 5

A-C GENERATING SYSTEM

Section I

A-C GENERATOR

79. DESCRIPTION (figs. 139 and 140).

a. The a-c generator consists of two generators mounted on the same shaft in the same housing. The smaller of the two generators, the exciter, is a direct-current stationary field type. Its function is to furnish direct-current excitation for the revolving field coils of the other generator. The other generator, the alternator, is an alternating-current revolving field type generator. Its function is to deliver the electrical output of the unit. The exciter is located to the rear of the alternator. A brush holder assembly is located to the rear of the exciter just in front of the single generator bearing. This holder serves both the exciter commutator brushes and the alternator slip ring brushes. Brush holders are radial box type. They are readily accessible by removing guards and covers from rear of generator. Fans, to cool the assembly during operation, are keyed to the front and rear ends of the shaft. Both fans are outside the generator housing proper. The rear fan is covered by a guard. The front fan is within the engine bell housing and is attached by cap screws. It serves as a part of the flexible coupling between the rotor and engine.

b. The exciter armature coils are mounted on a sleeve which is keyed to and pressed onto the rotor shaft. The armature is removable as an assembly. The exciter field coils are attached to the rear bracket by pole pieces and screws. They can be replaced individually.

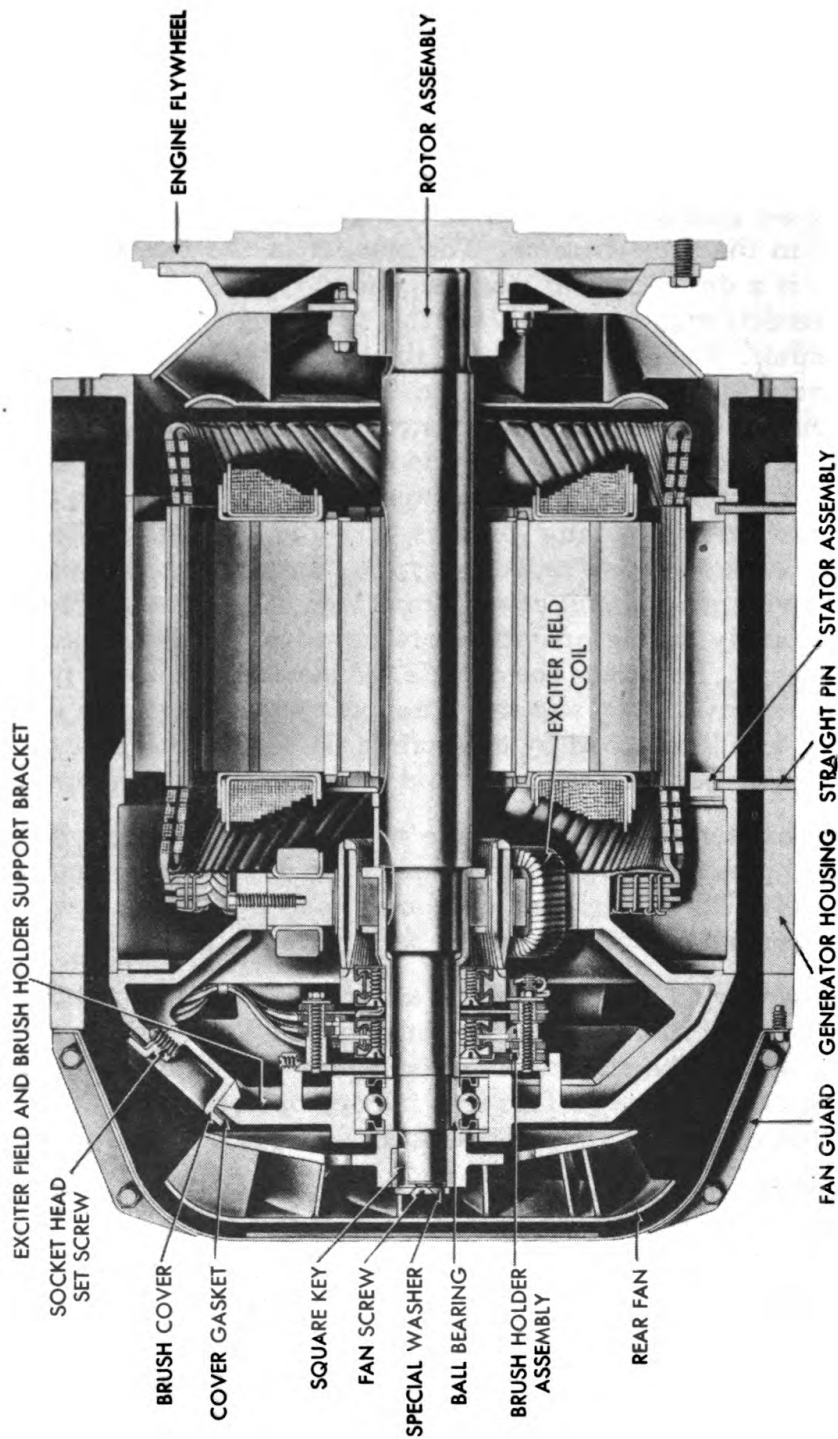
c. The revolving field coils of the alternator are pressed onto and keyed to the rotor shaft. They are not designed to be removed as a service operation. The alternator stator is pressed into and pinned to the housing at the factory. This is a factory operation and it is not intended that either the stator or housing be serviced separately.

d. At 1,200 revolutions per minute, this 3-phase, 60-cycle, 30-kilowatt, 80 percent power factor generator delivers a maximum 165 amperes at 125 volts, or 85 amperes at 250 volts. Voltage delivered depends on the setting of the generator terminal box on the upper left side of the generator housing.

80. SPECIFICATIONS.

Model	M3
Speed	1,200 rpm
Voltage	125 or 250

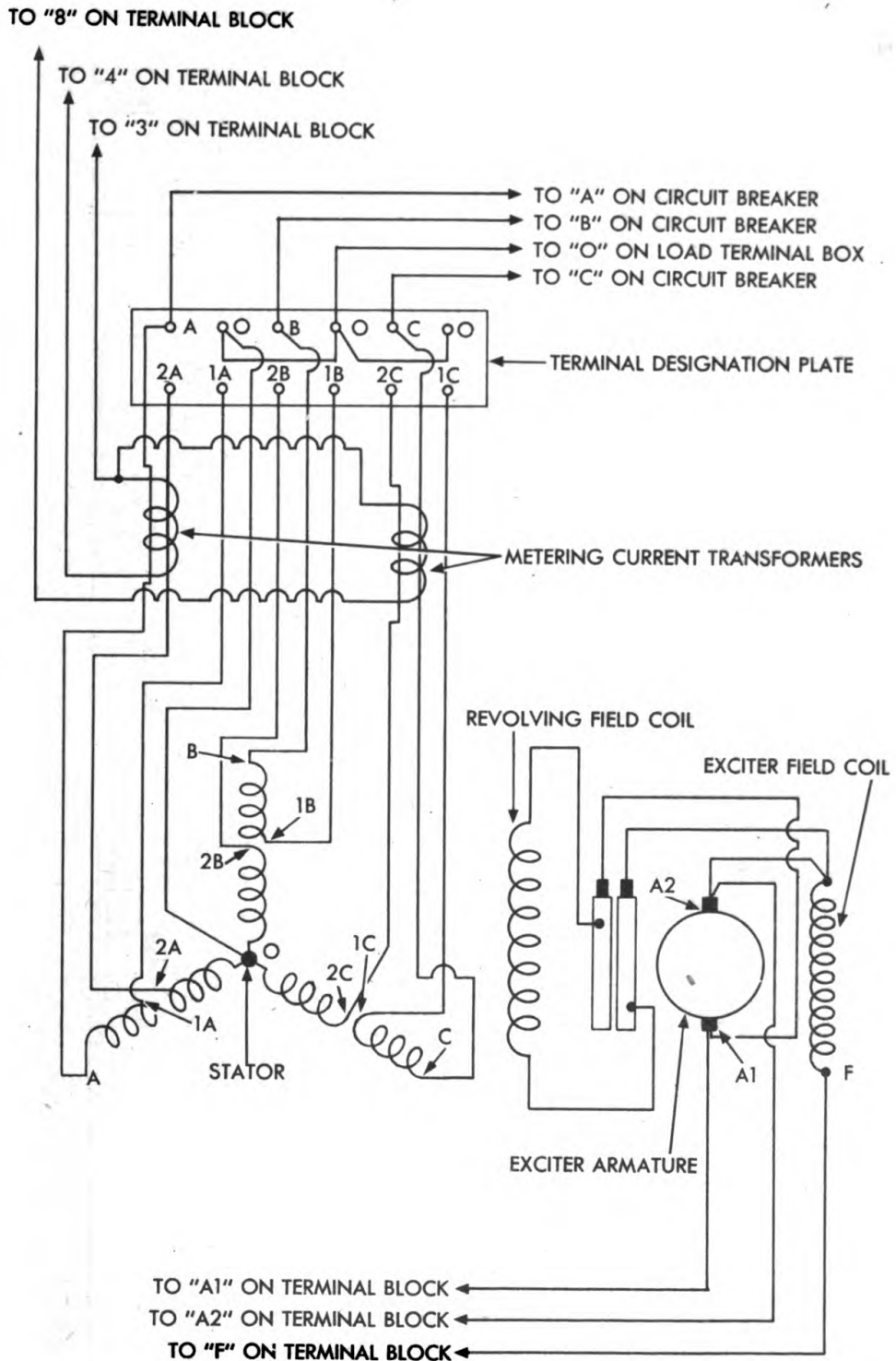
ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78522

Figure 139—A-C Generator—Cross Section View

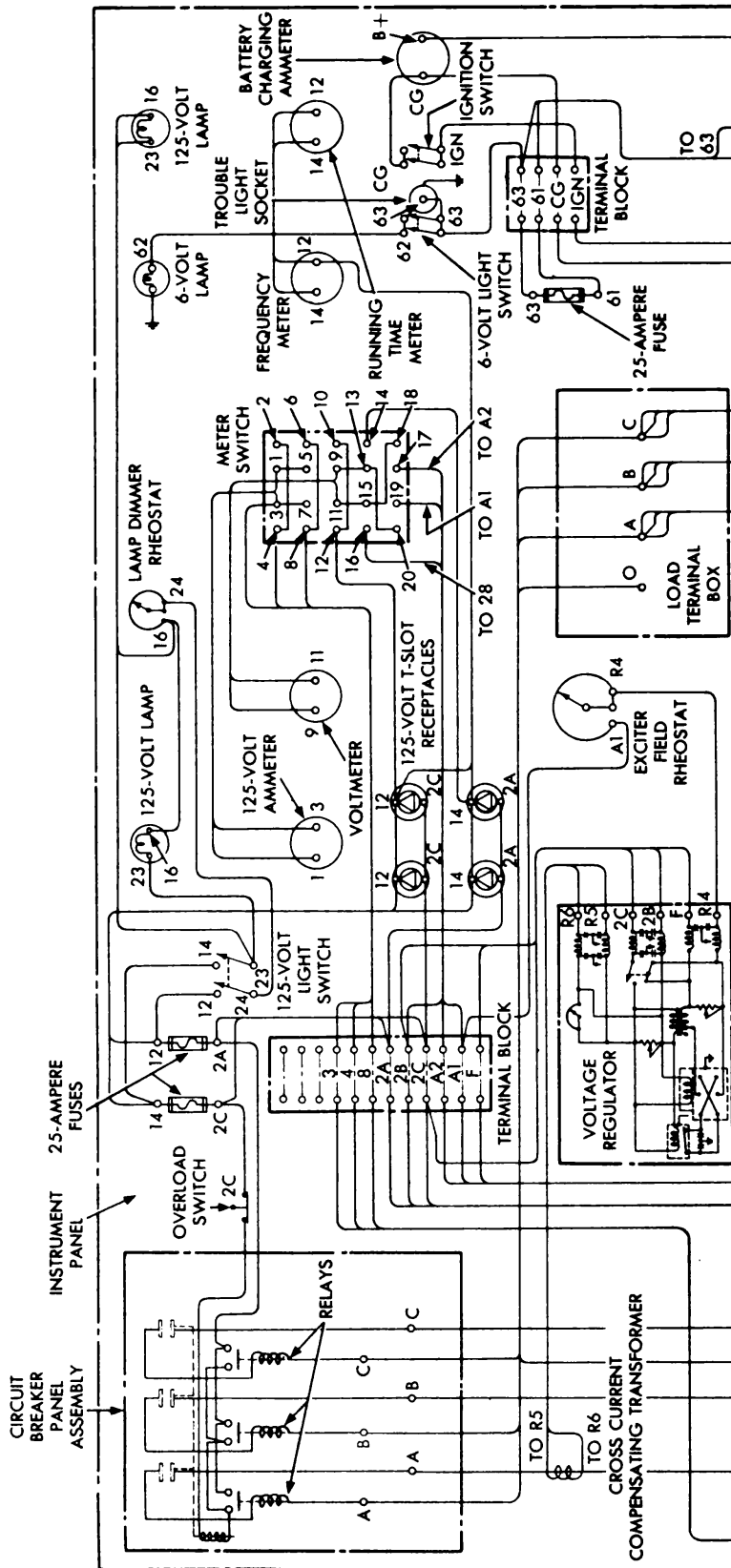
A-C GENERATING SYSTEM



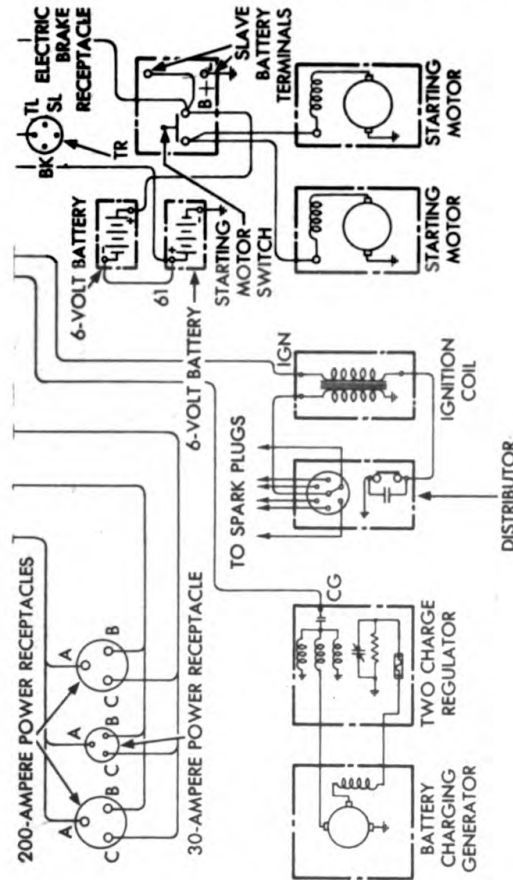
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Figure 140—A-C Generator Wiring Diagram

ORDNANCE MAINTENANCE—GENERATING UNIT M18



A-C GENERATING SYSTEM

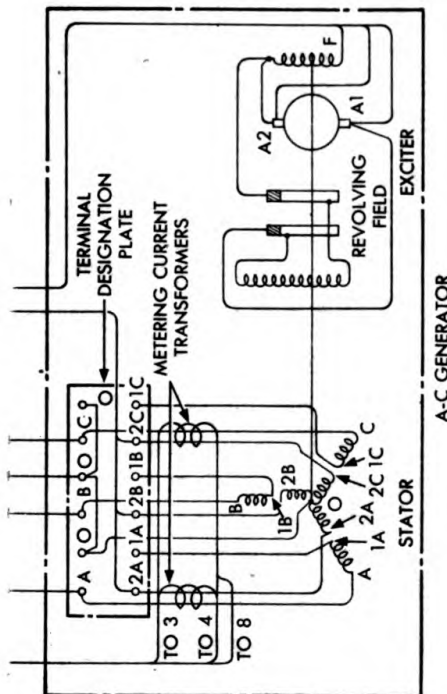


SMALL WIRE COLOR CODE

LINE A—RED TRACE
LINE B—GREEN TRACE
LINE C—BLUE TRACE
EXCITER A1—BLACK TRACE
EXCITER A2—WHITE TRACE
12-VOLT—BLACK FIELD
EXCITER A2—WHITE FIELD

RA PD 78600

Figure 141—Wiring Diagram of Generating Unit M18



METER SWITCH CONNECTIONS			
POSITION A	POSITION B	POSITION C	POSITION EXC
1 TO 2	1 TO 2	3 TO 4	3 TO 4
7 TO 8	5 TO 6	5 TO 6	7 TO 8
9 TO 10	13 TO 14	11 TO 12	17 TO 18
15 TO 16	15 TO 16	13 TO 14	19 TO 20

ORDNANCE MAINTENANCE—GENERATING UNIT M18

Amperage (max):

At 125 volts	162 to 165 amp
At 250 volts	81 to 85 amp

Phase	3
Cycle	60
Power factor	0.8
KVA	35
KW	28

Direct-current excitation:

Amperes	10.8
Volts	62.5

Temperature rise:

Armature	65°C
Field	65°C

Time rating 25 percent overload, 2 hr

Rotation (viewed from front end)..... Clockwise

81. REMOVAL.

a. Remove all four doors, hood, both rear side panels, gasoline tank (par. 37 a), instrument panel (par. 92), battery and tool box shelf, and rear upright frame.

b. Place blocks between engine bell housing and frame to support rear end of engine when generator is disconnected.

c. Remove the eight cap screws and lock washers which attach each of the two engine bell housing cover plates to bell housing. Lift plates and gasket from engine.

d. On adjacent points of generator fan and engine flywheel, prick-punch marks to make possible assembly in same position.

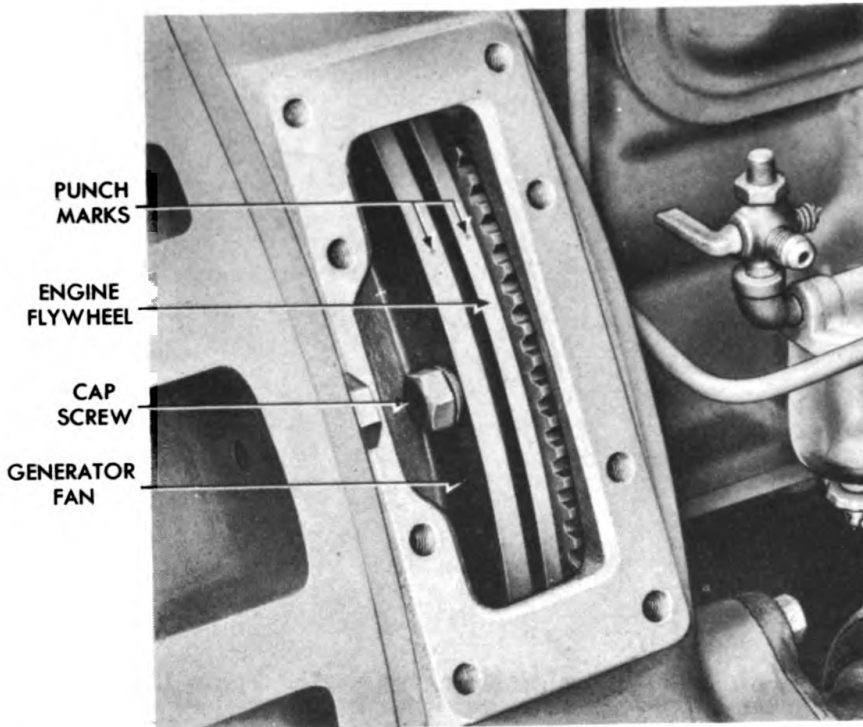
e. Remove the eight cap screws and lock washers which attach generator fan to engine flywheel (fig. 142).

f. Remove cap screws and lock washers which attach fan guard to rear of generator. Lift guard from generator.

g. Connect a hoist to a chain sling attached to exciter field and brush holder support bracket, and front end of starter housing. Remove top center bell housing to generator cap screw and install screw on inside of housing vent hole to attach chain (fig. 143). Support weight of generator with hoist.

h. Remove the 12 screws and lock washers which attach engine bell housing to generator housing.

A-C GENERATING SYSTEM



RA PD 78514

Figure 142—Generator Fan to Engine Flywheel Attachment

- i. Remove the four nuts, lock washers, cap screws, and special washers which secure generator to frame.
- j. Swing generator back to clear engine (fig. 143) and lift from unit.

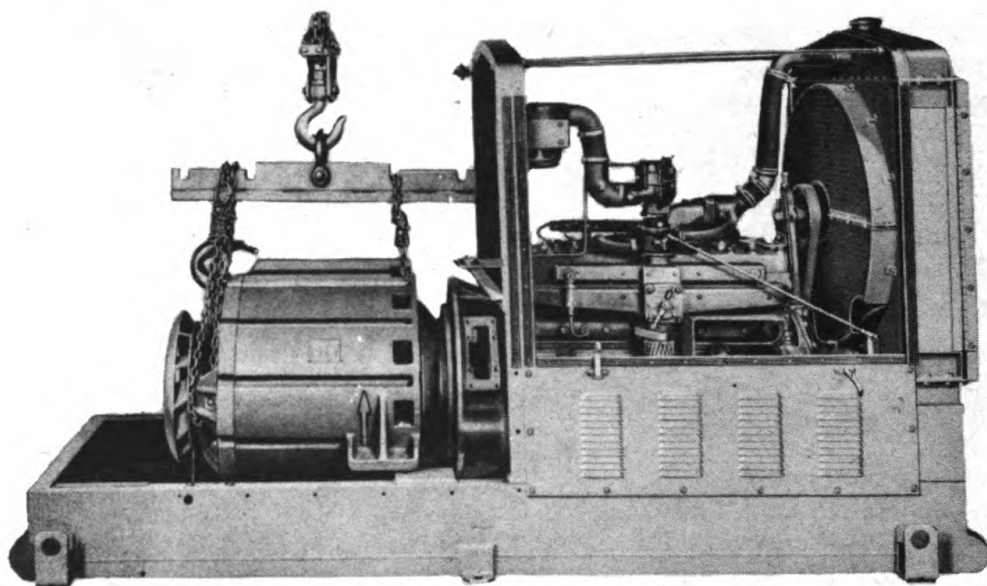
82. DISASSEMBLY.

a. Remove Rear Fan and Exciter Field and Brush Holder Support Bracket.

- (1) Remove fan screw and special washer which attaches rear fan to rotor shaft. Pull fan from shaft. Tap key from shaft (fig. 144).
- (2) Lift all brushes in holders so arm and spring hold them clear of rotor.
- (3) Remove eight cap screws and lock washers which attach exciter field and brush holder support bracket to rear of housing (fig. 144). Lift bracket from generator (fig. 145).

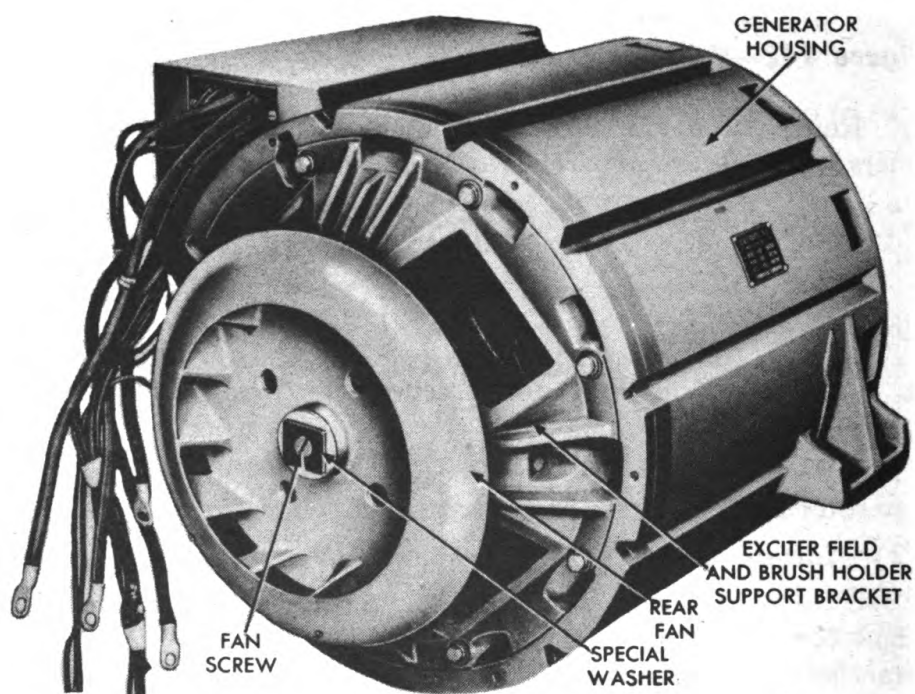
b. Remove Front Fan (fig. 146). Remove the four special nuts, washers, and bolts which attach laminated coupling disks to shaft spider. During removal of nuts, hold bolts with a $\frac{5}{8}$ -inch open-end

ORDNANCE MAINTENANCE—GENERATING UNIT M18



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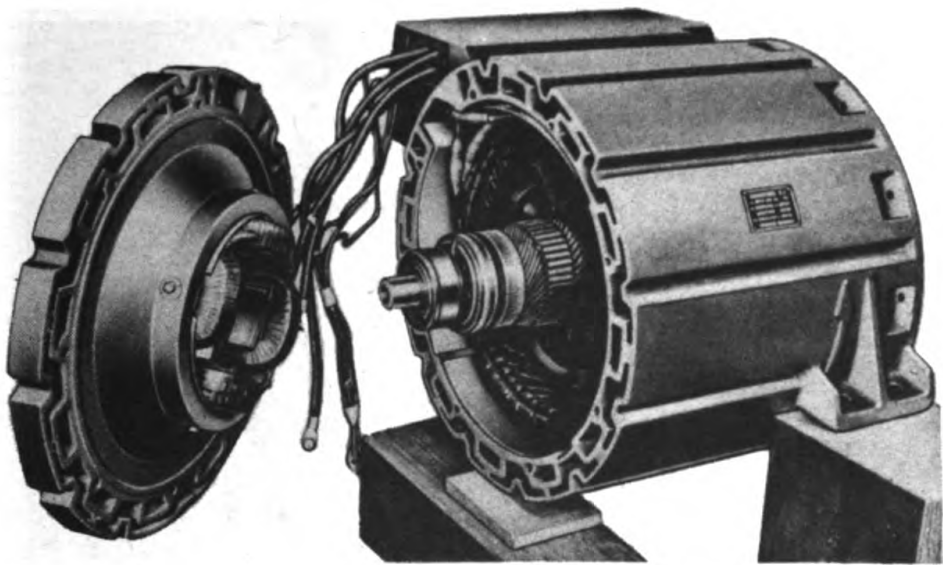
Figure 143—Hoisting Generator From Unit



RA PD 78552

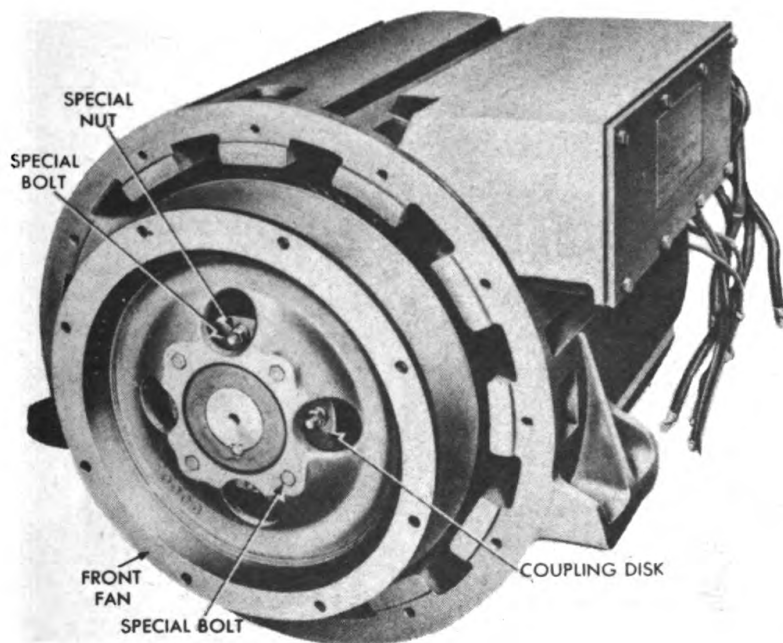
Figure 144—A-C Generator—Fan Guard and Brush Covers Removed

A-C GENERATING SYSTEM



RA PD 78558

Figure 145—Exciter Field and Brush Holder Support Bracket Removal



RA PD 78573

Figure 146—A-C Generator Front Fan Attachment

ORDNANCE MAINTENANCE—GENERATING UNIT M18

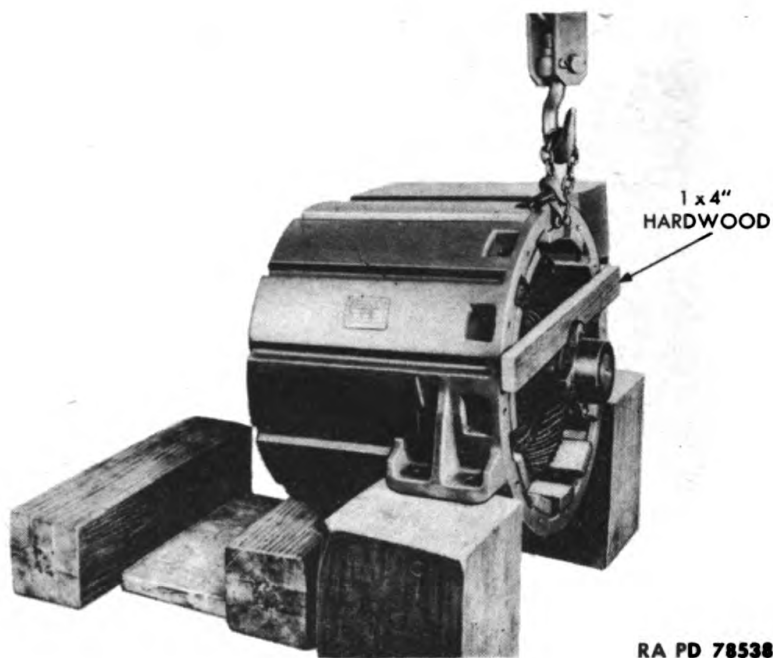
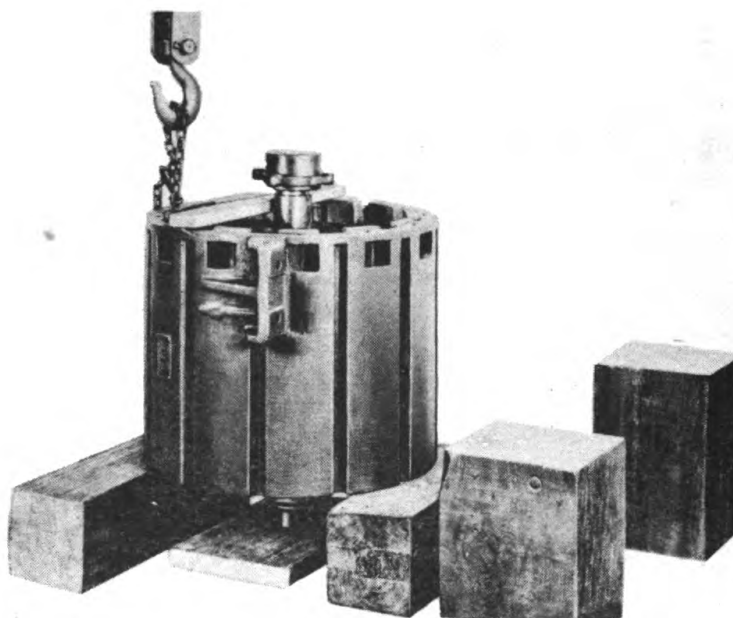


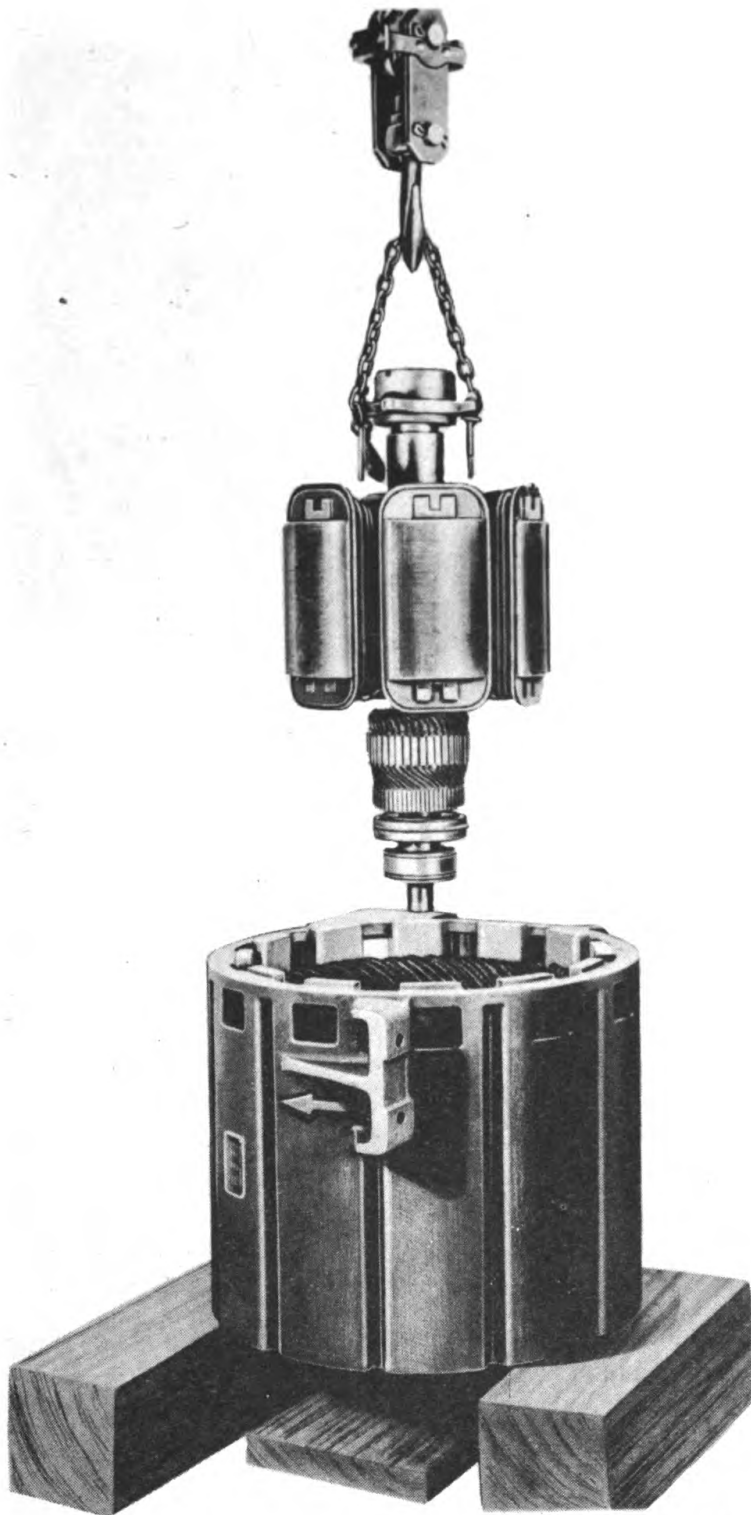
Figure 147—Positioning Generator for Rotor Removal (1)



RA PD 78570

Figure 148—Positioning Generator for Rotor Removal (2)

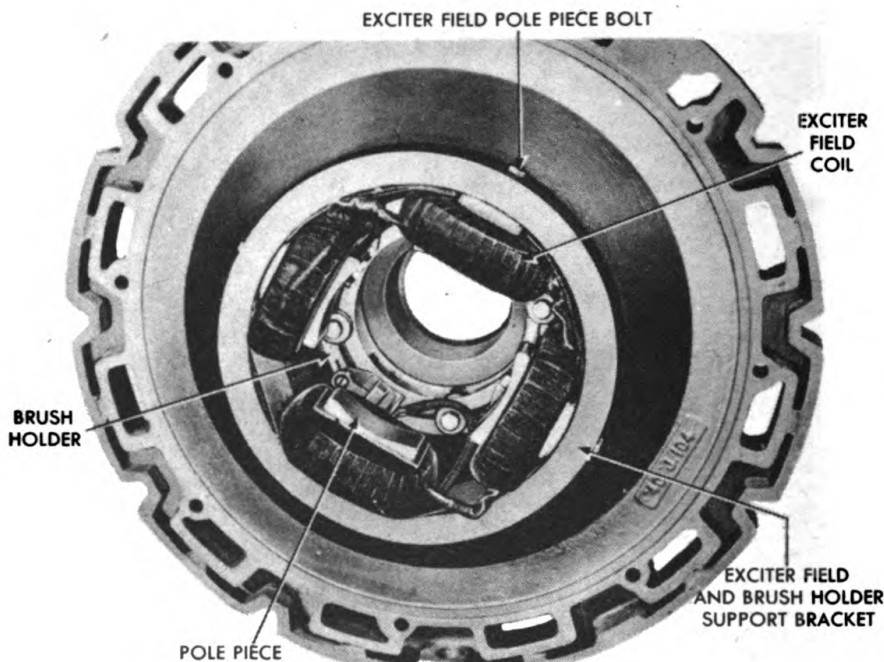
A-C GENERATING SYSTEM



RA PD 78530

Figure 149—A-C Generator Rotor Removal

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78559

**Figure 150—Exciter Field and Brush Holder Support Bracket—
Coils and Holder Installed**

wrench inserted behind fan. Lift fan with attached coupling from front end of generator.

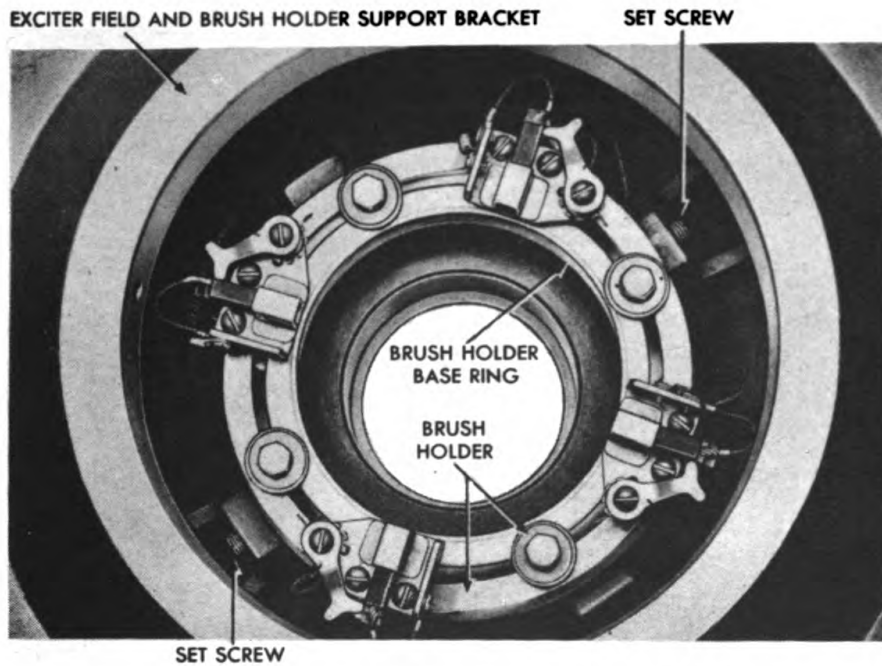
c. Remove Rotor.

(1) Place a timber of same size used to block up back of generator about 2 feet behind block under rear of generator. Lay a board on floor between blocks positioned so as to protect end of rotor shaft when generator is tipped back onto rear blocks. Place a 1-inch hardwood board across front end of housing under rotor spider. This board is to keep rotor from sliding back when generator is tipped (fig. 147).

(2) Attach a chain loop to top center of front end of housing with a cap screw. Attach hoist to chain loop. Lift generator assembly and tip it back onto blocks (fig. 148). Shift back block as necessary to keep from crushing lead wires which extend from rear of housing.

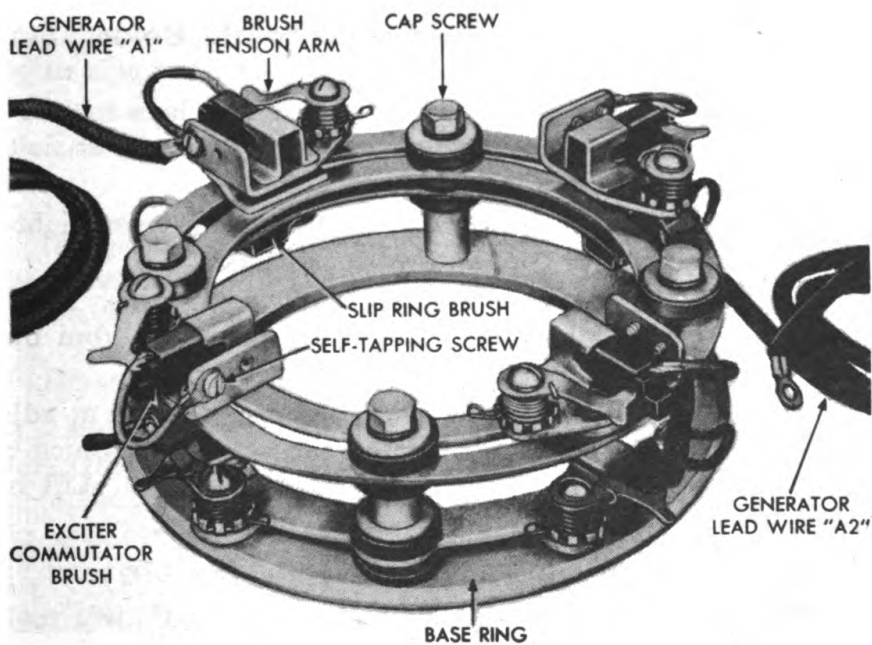
(3) Insert two bolts through bolt holes in rotor spider and attach a chain loop to them. Hook loop over hoist and lift rotor from housing (fig. 149).

A-C GENERATING SYSTEM



RA PD 78568

Figure 151—Brush Holder Installed in Bracket



RA PD 78515

Figure 152—Brush Holder Assembled

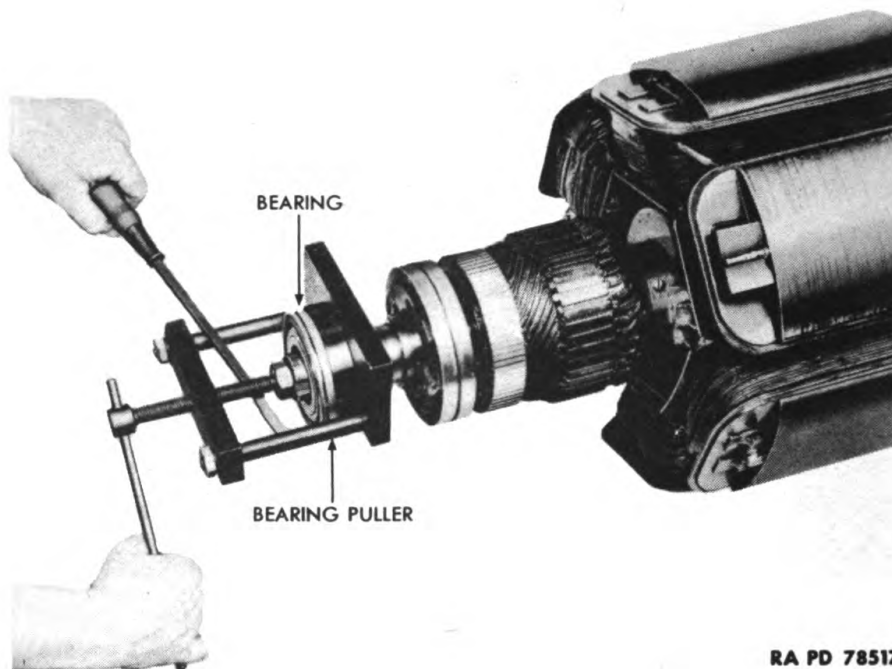


Figure 153—Pulling Bearing From Rotor Shaft

d. Disassemble Exciter Field and Brush Holder Support Bracket.

(1) Remove sealing compound from wire exit hole to free wires for removal. Use care to avoid cutting wires. Pull exciter field coil lead wire through hole into inside of bracket.

(2) Disconnect exciter field coil lead wire from lower right-hand commutator brush holder (opposite wire exit hole).

(3) Remove the 4 exciter field coil pole piece bolts. Lift the 4 connected field coils, 4 pole pieces, and 16 insulators from bracket (fig. 150).

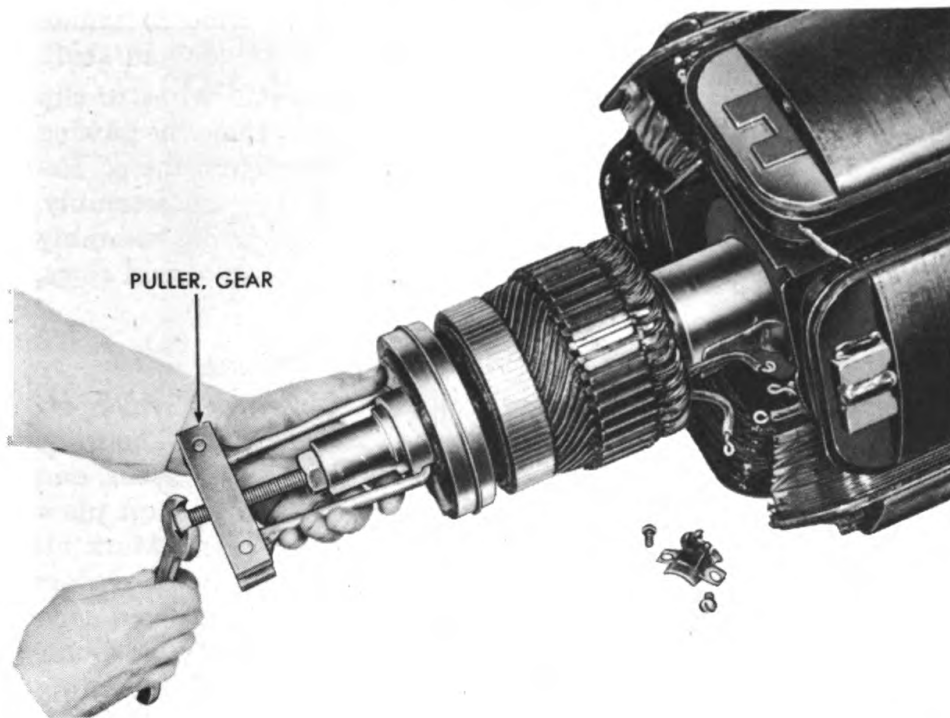
(4) Prick-punch brush holder base ring and bracket at adjacent points to facilitate assembly. Loosen the two set screws which clamp holder in bracket, with an offset screwdriver (fig. 151). Lift holder assembly from bracket.

e. Disassemble Brush Holder Assembly (fig. 152).

(1) Remove all screws which attach brush lead wires to brush holders. Lift all brushes and generator lead wires "A1" and "A2" from brush holders.

(2) Remove the four cap screws which secure the entire assembly to base ring. Remove washers, spacers, and bushings.

A-C GENERATING SYSTEM



RA PD 86598

Figure 154—Exciter Armature

(3) Remove the two screws which attach each commutator brush holder to ring assemblies. Lift holders from rings.

(4) Unscrew nut and remove screw from hub of each brush tension arm. Lift arm, spring, special washer, and bushing from each holder.

f. Disassemble Front Fan Assembly. Remove the 4 nuts, lock washers, and bolts which attach flexible coupling disks to fan. Lift the 17 disks from fan.

g. Disassemble Rotor Assembly.

(1) Rotor is statically and dynamically balanced. Do not disassemble more than necessary for repair or replacement of parts. When replacing parts, select new part of as near same weight as old part as possible in order to preserve balance. Pull bearing from rear end of rotor shaft (fig. 153).

(2) Press flexible coupling spider from front end of shaft. Tap key from shaft.

(3) Disconnect slip ring to revolving field coil wires at connection adjacent to field coils. Tag or mark wires to expedite connecting them in same order at time of assembly. Install a gear puller on

ORDNANCE MAINTENANCE—GENERATING UNIT M18

armature sleeve in holes drilled for the purpose at time of manufacture. Pull armature from shaft. Tap key from keyway in shaft.

(4) Melt solder which attaches revolving field coil wires to slip rings (one wire on each ring). Free wires from slip rings by picking off any insulating compound which may cause wires to adhere. Remove two diagonally opposite screws from end of slip ring assembly. Using these screw holes to attach gear puller, pull slip ring assembly from sleeve. Remove remaining four screws and separate end rings, insulating rings, and slip rings from separator.

h. Disassemble Housing and Stator Assembly (fig. 168).

(1) Remove the eight cap screws and lock washers which attach generator terminal box cover to housing. Lift cover from housing. Remove, in order given, nut, lock washer, link, nut, lock washer, and flat washer from each terminal bolt. Lift terminal designation plate from terminal bolts. Lift flat washers from terminal bolts. Mark all wires connected to terminal bolts with a steel scribe to make correct assembly easier. Remove nut, lock washer, and flat washer from each terminal bolt. Push bolts in as necessary and free wires from bolts. Remove the four cap screws and lock washers which attach mounting plates. Lift terminal plate from housing. Pull terminal bolts from terminal plate. Slide flat washers from terminal bolts. Slide U-shaped copper links from "O" terminal bolts. Remove the two nuts, two lock washers, two bolts, and eight flat washers which attach each of the two mounting plates to terminal base plate. Lift mounting plates from base plate.

(2) Remove sealing compound from wire exit hole in housing and pull metering current transformer lead wires into inside of housing. Slide metering current transformers from "A" and "2A" stator lead wires and from "C" and "2C" stator lead wires. Pull generator lead wires marked "A," "B," "C," and "O" from housing wire exit hole.

(3) Pick the two pieces of insulation from end of stator within rear end of housing.

83. INSPECTION.

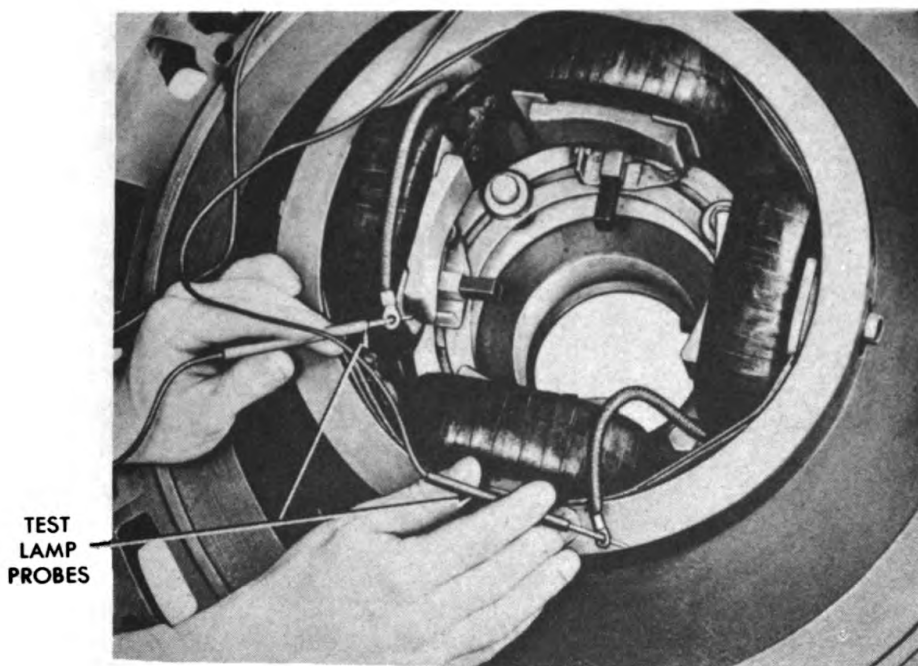
a. Cleaning. Blow dirt from windings with compressed air. Clean metal parts with dry-cleaning solvent and dry with compressed air. Do not get solvent on coils or wires.

b. General.

(1) Inspect all castings to see if any are cracked or broken. Check condition of threads in all tapped holes. Inspect air passages to see if they are obstructed.

(2) Check condition of all keys and keyways to see if keys are bent, broken, or burred, or if keyways are spread or burred.

A-C GENERATING SYSTEM



RA PD 78534

Figure 155—Checking Exciter Field Coils for Open Circuit

(3) Inspect all bolts, nuts, screws, and washers to see if any are bent, broken, burred, or have stripped threads.

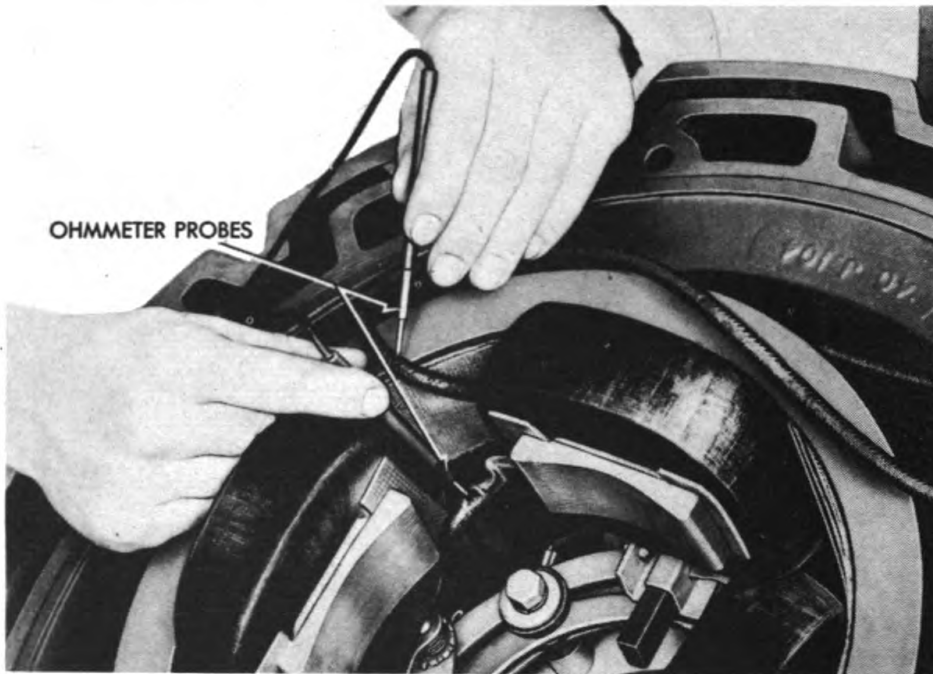
(4) Check condition of insulation on all wires and coils. Notice if it has been damaged by accident or deteriorated from age or adverse weather conditions. Signs of heat on coils or wires indicate a short circuit.

(5) Examine rear fan cover to see if it is bent or broken or if screen attaching welds are loosened.

(6) Check condition of disks in flexible coupling to see if any are broken.

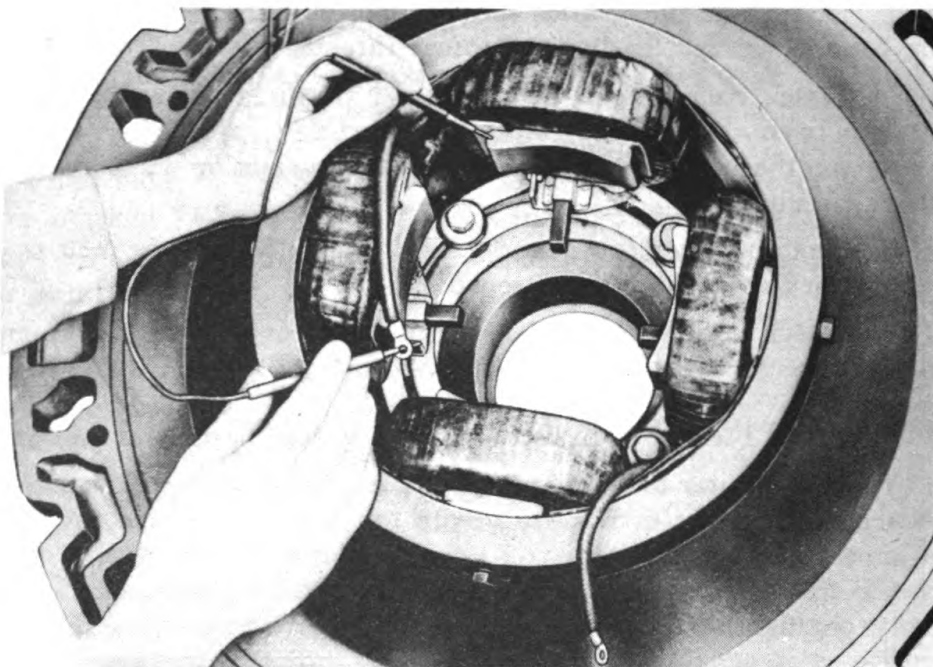
c. Exciter Field and Brush Holder Support Bracket Assembly.

(1) Test exciter field coils for an open circuit with coils installed in bracket (fig. 155) or removed from bracket. Touch one probe of test lamp on tip of lead wire from coil to exciter brush. Touch other probe to tip of generator lead wire from coil to exciter brush. Touch other probe to tip of generator lead wire "F." If lamp lights, no open circuit is present. Failure of lamp to light indicates an open circuit. Remove insulation from connections where coils are joined and test coils individually to locate faulty coil.



RA PD 78555

Figure 156—Checking Exciter Field Coils for Short Circuit



RA PD 78539

Figure 157—Checking Exciter Field Coils for Ground

A-C GENERATING SYSTEM

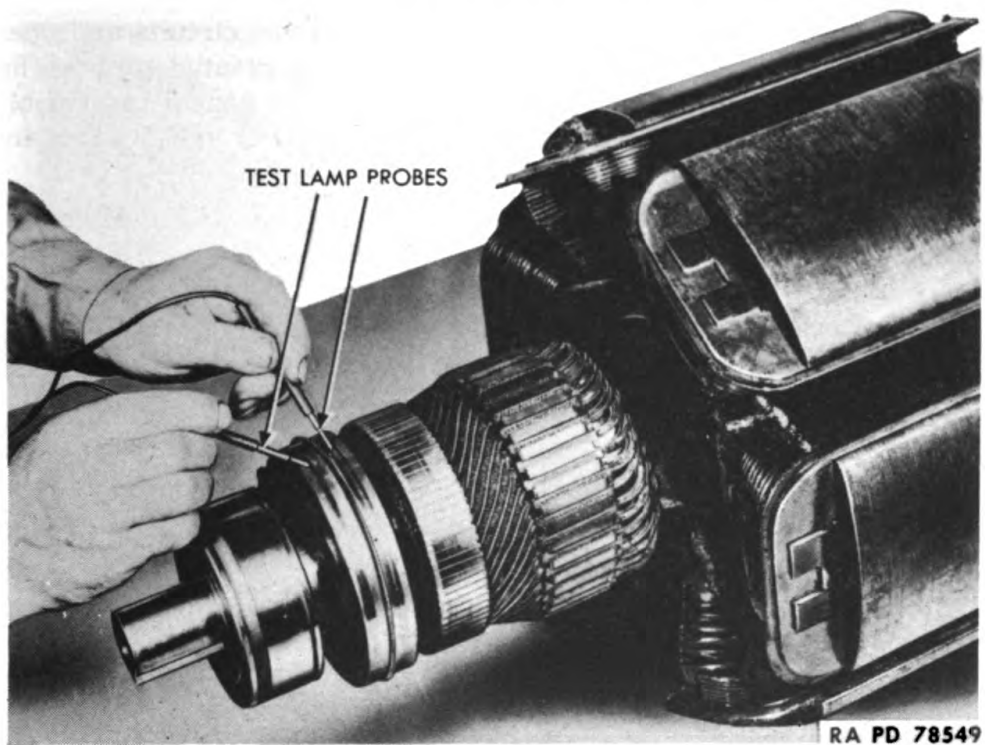


Figure 158—Checking Revolving Field Coils for Open Circuit

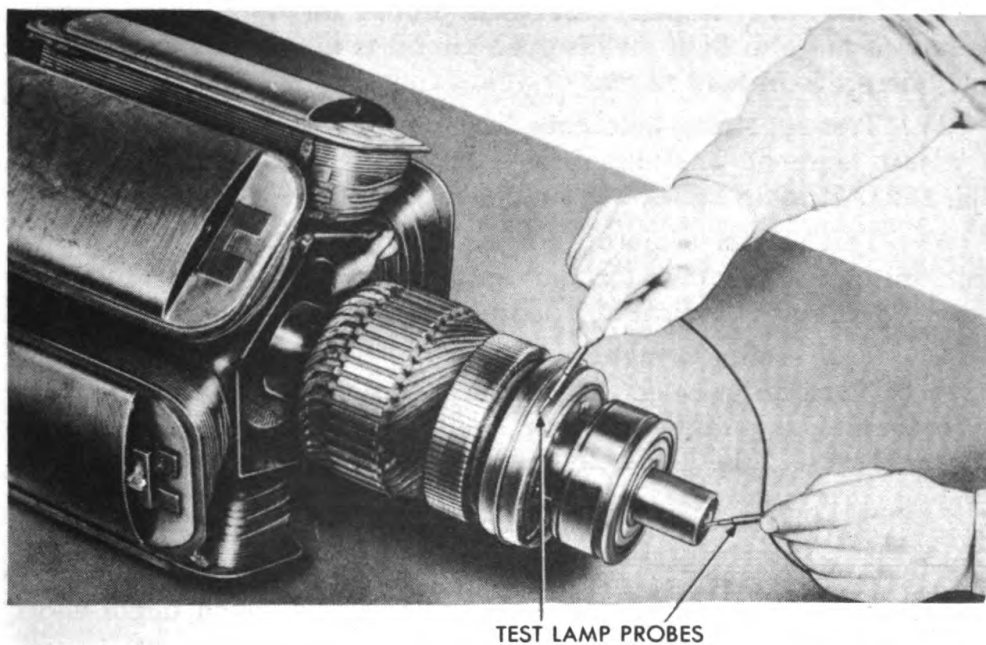


Figure 159—Checking Revolving Field Coils for Ground

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(2) Test individual exciter field coils for short circuits and open circuits with an ohmmeter equipped with sharp pointed probes (fig. 156). A short circuit is indicated in any coil which has an appreciably lower resistance than the others. An open circuit is indicated in any coil which shows an infinite resistance.

(3) Test exciter field coils for a ground (fig. 157). Hold one probe of test lamp to tip of lead from coils, touch other probe to pole piece of coil. If lamp lights, coils are grounded. *NOTE: This test is made with field coils installed in support bracket.*

(4) Inspect all brushes to see if any are broken or worn out (three-quarters inch long or less).

(5) Inspect brush springs to see if they are bent, broken, or weakened.

(6) Examine all insulating washers and bushings to see if they are broken or otherwise damaged.

(7) Check condition of rings, holders, and spacers to see if any are bent, broken, or worn.

d. Rotor Assembly.

(1) Test revolving field coils for an open circuit (fig. 158). Place one probe of test lamp on each slip ring. Failure of lamp to light indicates an open circuit. In case an open circuit is indicated, remove insulation from coil to slip ring lead wires at connections adjacent to coils. Repeat test with probes on bared connections. Failure of lamp to light means open circuit is in coils. If lamp lights, open circuit is in lead wires.

(2) Test revolving field coils for a ground by placing one probe of a test lamp on one slip ring. Touch other probe to rotor shaft (fig. 159). If lamp lights, a ground is indicated.

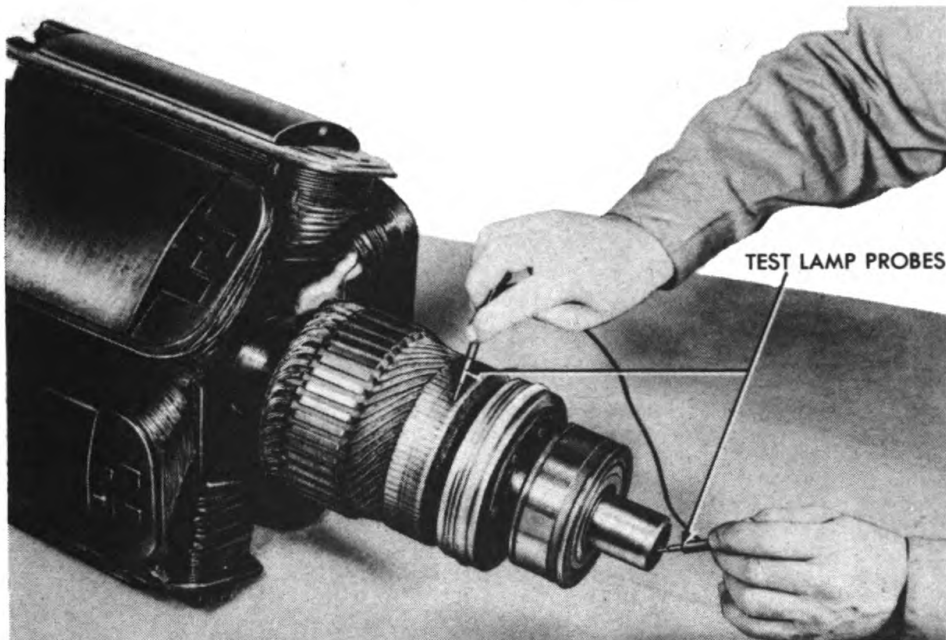
(3) Test exciter armature for a ground by touching probes of a test lamp to a commutator bar and to rotor shaft (fig. 160). A grounded circuit is indicated if lamp lights.

(4) Test exciter armature for a short circuit by placing it in a growler. Turn on growler. Move steel strip slowly around armature coils, keeping it parallel to rotor shaft and about one-quarter inch from coil cores (fig. 161). Turn off growler and revolve armature one-half turn in growler and test other half of armature. If steel strip vibrates noticeably or is drawn to laminations, a short circuit is indicated.

(5) Inspect commutator bars. Look for burs which might short circuit two adjacent bars. Observe whether or not bars are scored.

(6) Inspect slip rings to see if they are scored (rare). Examine separator to see if it was broken due to improper disassembly.

A-C GENERATING SYSTEM



RA PD 78531

Figure 160—Checking Exciter Armature for Ground

(7) Revolve rotor shaft bearing slowly and listen for noise indicating damage or wear. Test bearing for noticeable side play indicating wear. Structure of bearing makes it impossible to examine races or balls directly.

e. Housing and Stator.

(1) Test stator windings for an open circuit as follows (fig. 162): Remove links from terminal bolts in generator terminal box. Test for an open circuit with test lamp by placing probes on terminals "A" and "1A," "B" and "1B," "C" and "1C," "2A" and "2B," and "2A" and "2C," respectively. If lamp fails to light on any test, an open circuit is indicated.

(2) Test stator windings for ground with a test lamp before replacing generator terminal box links (fig. 163). Hold one test lamp probe to frame. Touch other probe to terminals "A," "B," "C," and "O" respectively. A ground is indicated if lamp lights on any test.

(3) Test stator windings for a short circuit with a stator growler (fig. 164). Place growler within stator so steel strip on growler is parallel with and next to stator core laminations. Turn on growler and move slowly around entire inner circumference of stator. If stator windings have a short circuit, growler will "growl" due to vibration of steel strip.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

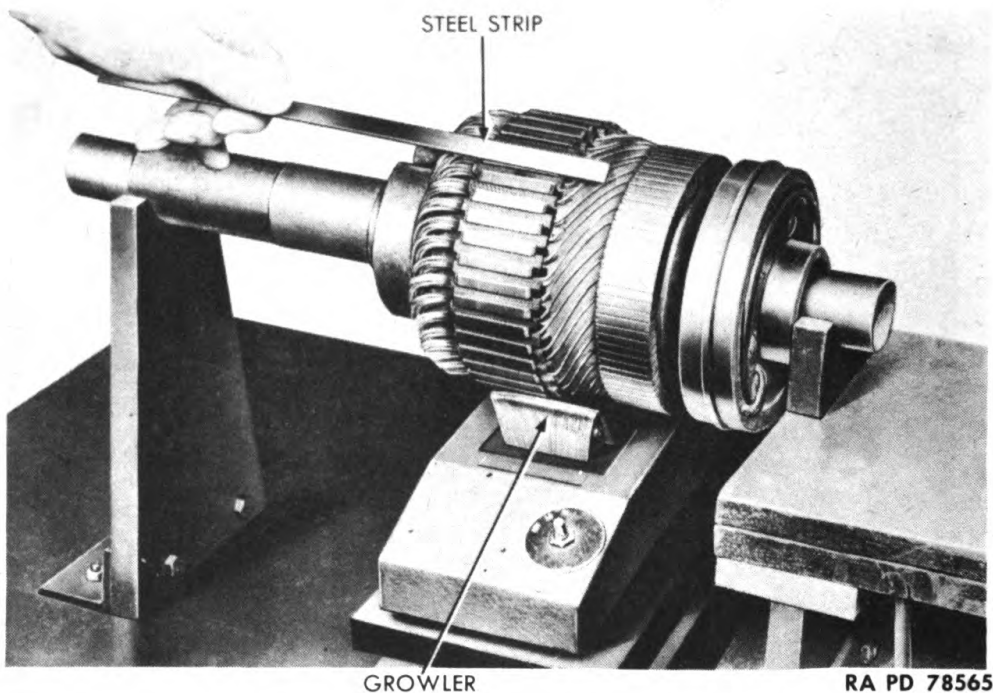


Figure 161—Checking Exciter Armature for Short Circuit

84. REPAIR.

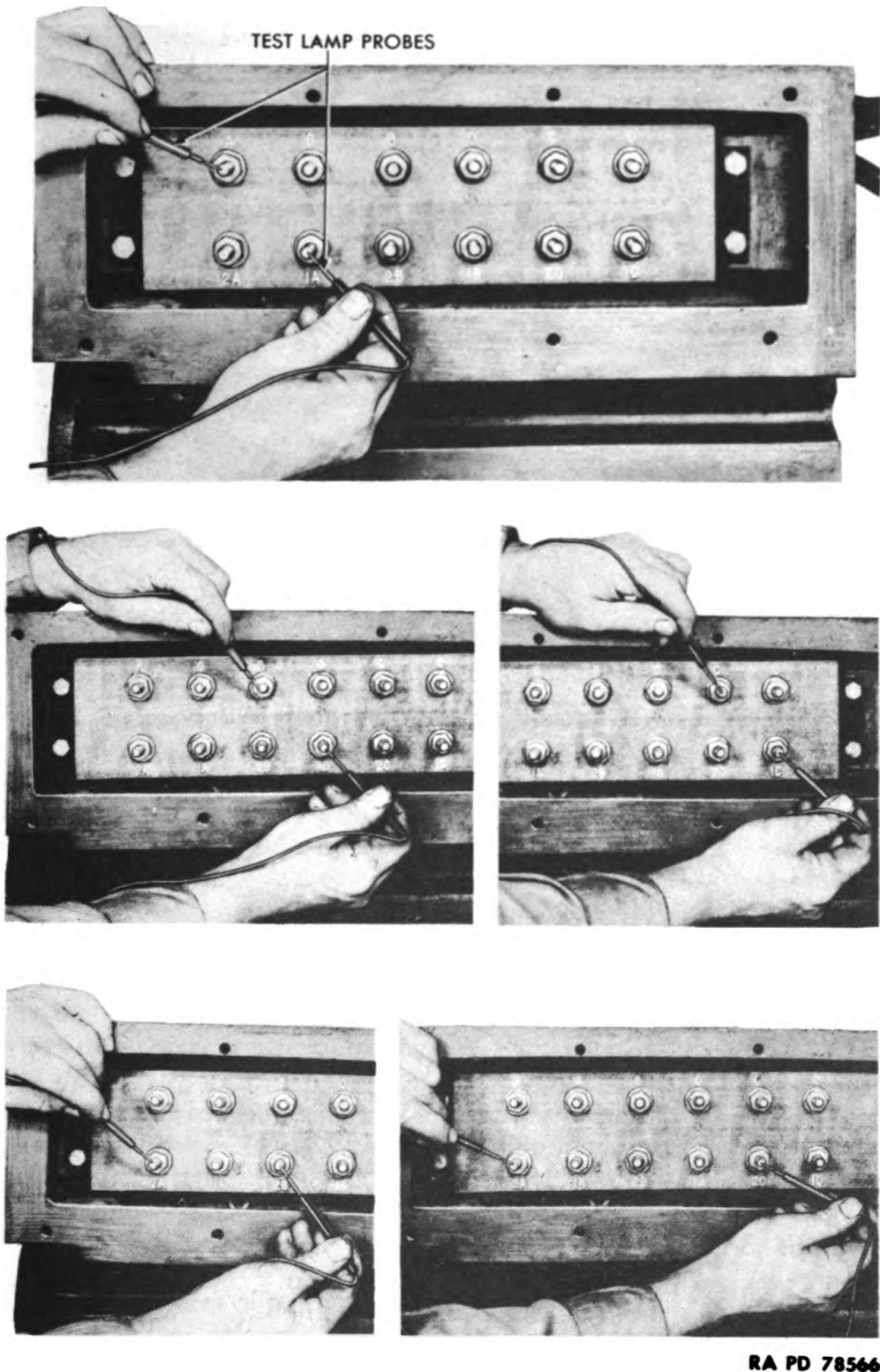
a. General.

- (1) Clean up threads which are stripped or burred with a thread tap. Blow or ram all obstructions from air passages.
- (2) Replace bent or broken keys. Remove burs from all parts with a fine mill file.
- (3) Replace all bolts, nuts, screws, and washers which are bent, broken, or stripped.
- (4) Repair damaged or doubtful insulation by wrapping with tape and/or painting with glyptal synthetic paint if possible. Otherwise, replace coil or wire.
- (5) Bump rear fan covers into original shape if bent. Weld covers if torn or if welds have loosened. Replace covers if beyond repair.
- (6) Replace broken disks in flexible coupling.

b. Exciter Field and Brush Holder Support Bracket Assembly.

- (1) If exciter field coils show an open circuit, short circuit, or ground, check connections and lead wires. If defect is located in leads

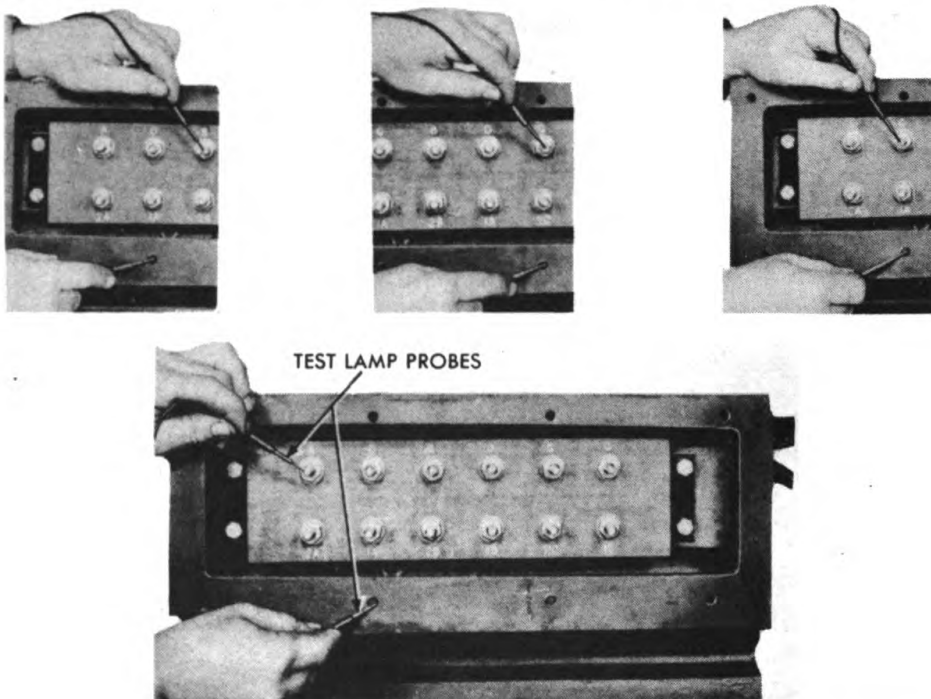
A-C GENERATING SYSTEM



RA PD 78566

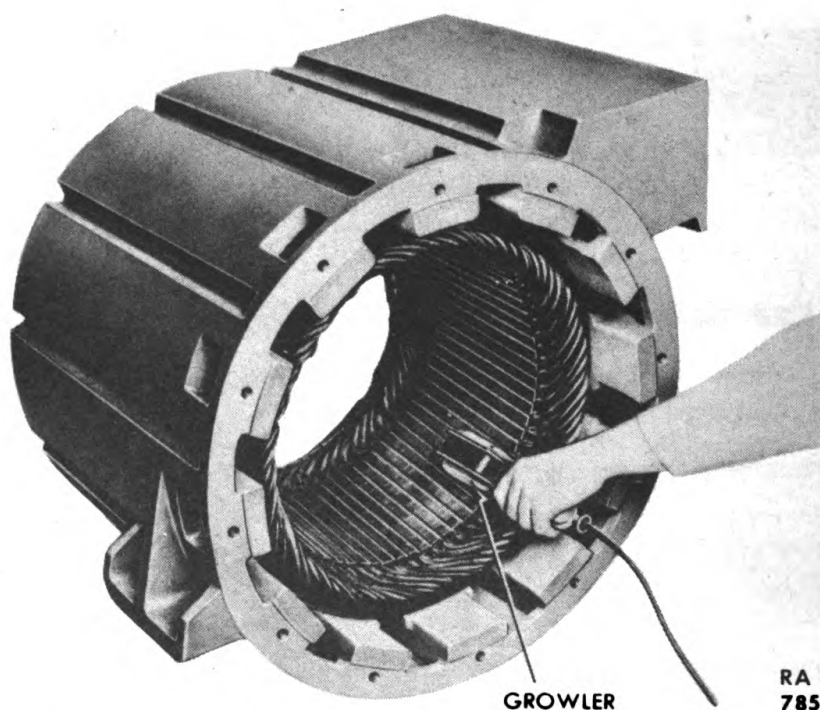
Figure 162—Checking Stator Windings for Open Circuit

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78532

Figure 163—Checking Stator Windings for Ground



RA PD
78529

Figure 164—Checking Stator Windings for Short Circuit

A-C GENERATING SYSTEM

or connections, connect and solder wires. Wrap connection in tape and paint with glyptal synthetic paint. If defect is within a coil, replace coil.

(2) Replace brushes which are broken or worn out (three-quarters inch or less in length).

(3) Replace bent, broken, or weakened brush springs.

(4) Straighten or replace metal parts of brush holder. If parts are straightened, check them carefully to see if they have been weakened. Replace broken, worn, or weakened parts.

c. Rotor Assembly.

(1) If revolving field coils have an open circuit, short circuit, or ground, carefully inspect lead wires and connections between coils and between coils and slip rings. If defect is found, solder connections, wrap with tape, and paint with glyptal synthetic paint. Otherwise, replace coil assembly or entire rotor.

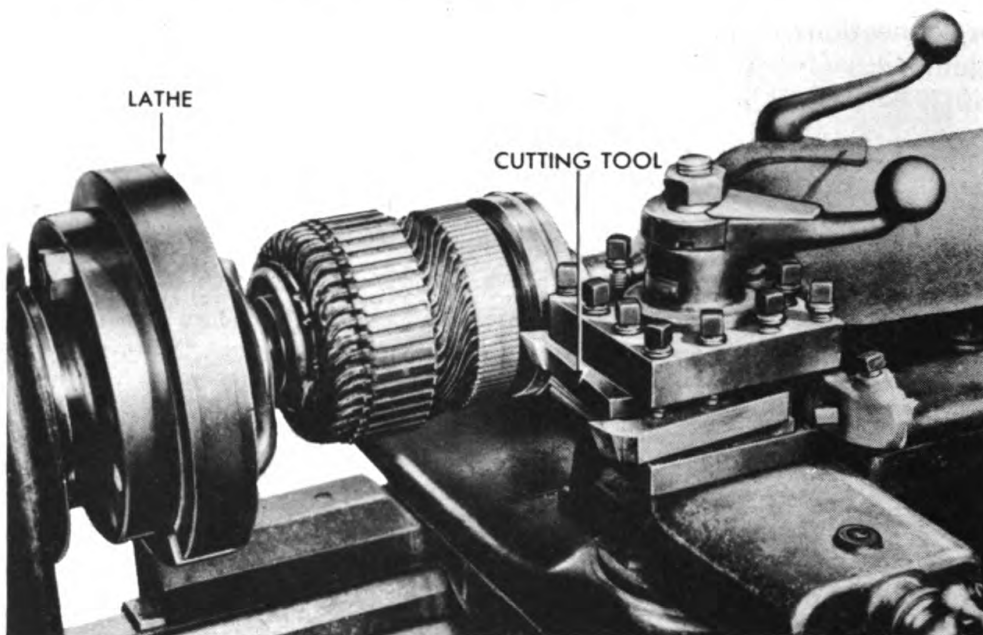
(2) Examine exciter armature if it has an open circuit. If cause is a wire pulled loose from a commutator bar, solder wire to slot in bar. Turn commutator down on a lathe and undercut the mica (step (3), below). Replace armature if short circuited or grounded.

(3) If exciter commutator bars are scored, place rotor assembly in a lathe. Take a cut from commutator bars (fig. 165). Make cut no deeper than necessary to remove all score marks. Hold a piece of flint paper, No. 2/0, against revolving commutator to remove cutting tool marks. With an undercutting machine, undercut mica between commutator bars to a depth of 0.0025 inch (fig. 166).

(4) If slip rings are scored, place rotor in a lathe. Take a cut just deep enough to remove score marks from slip rings. Hold a piece of flint paper, No. 2/0, against slip rings to remove cutting tool marks. Exercise care during entire operation to keep from injuring separator.

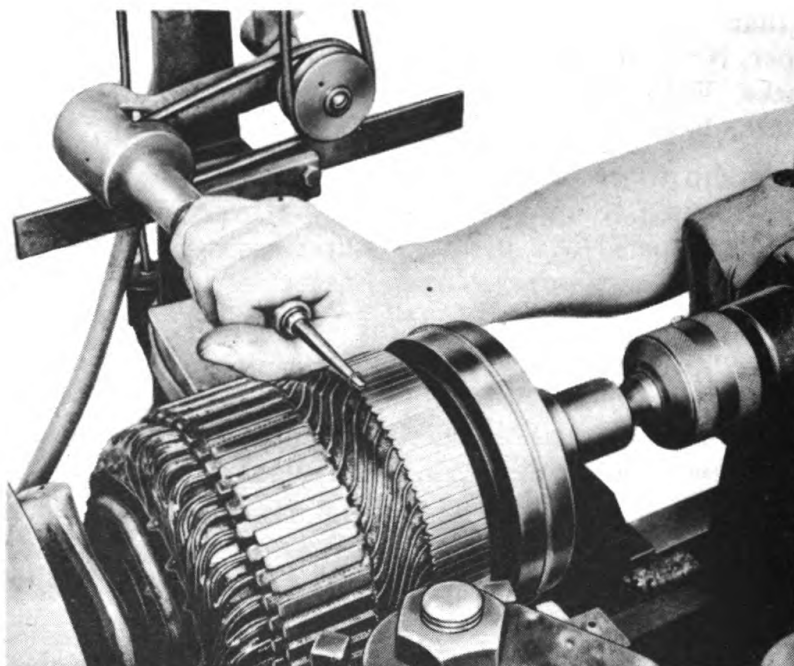
(5) If slip ring separator is broken, melt solder which attaches lead wire from revolving field to outer slip ring, and pry wire loose. Remove the six screws from end ring. Tap threads in two diagonally opposite screw holes in outer ring. Pull end ring from shaft with a gear puller. Lift insulating ring, outer slip ring, and separator from rotor. Install new separator and old slip ring, insulating ring, end ring, and the six screws respectively. Solder lead wire from revolving field coil to outer slip ring.

(6) Replace rotor bearing if noise or play indicates damage or wear. Remove lubrication screw from outer race of new bearing and fill bearing with lubricating grease (special). About 1 cubic inch of grease is required. Install screw.



RA PD 78504

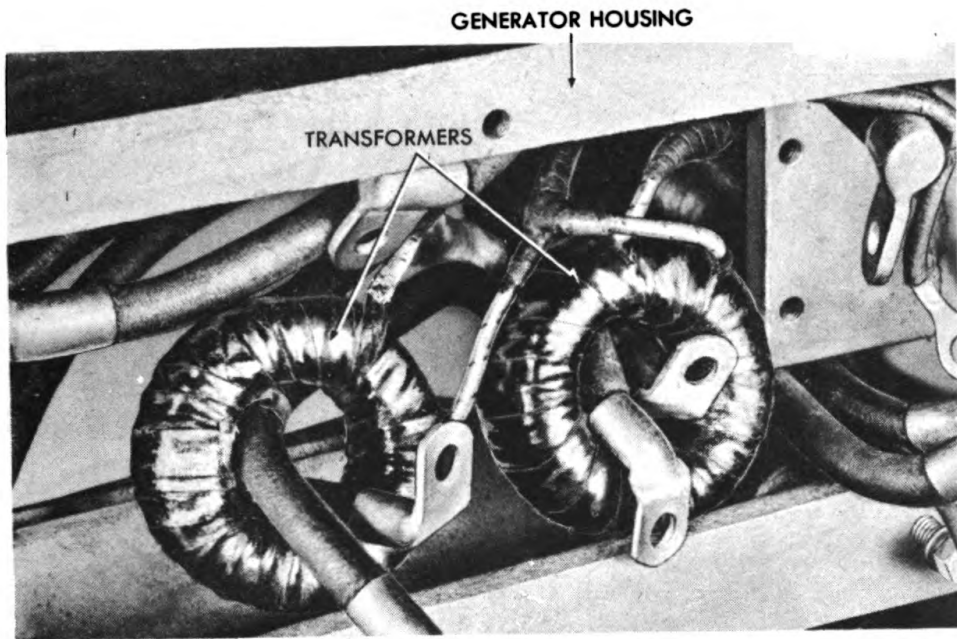
Figure 165—Exciter Armature in Lathe To Cut Commutator Bars



RA PD 78528

Figure 166—Undercutting Mica on Exciter Commutator

A-C GENERATING SYSTEM



RA PD 78526

Figure 167—Metering Current Transformers Installed

d. Housing and Stator.

(1) If stator windings have an open circuit, it probably is in leads or connections. Coils themselves are composed of three wires in parallel and it is improbable that all three wires would break. Remove tape and loom from connections and inspect welds. Test leads for an open circuit (par. 22 a). If defective connection or broken lead wire is located, weld wires together. Cover connection with loom and tape. Paint tape with glyptal synthetic paint. If open circuit is within a coil, replace entire stator.

(2) If stator windings are grounded, inspect lead wires and connections for faulty insulation. If uninsulated spot is located, install loom and tape. Paint loom and tape with glyptal synthetic paint. If ground is within a coil, replace stator.

(3) Replace stator if short circuited.

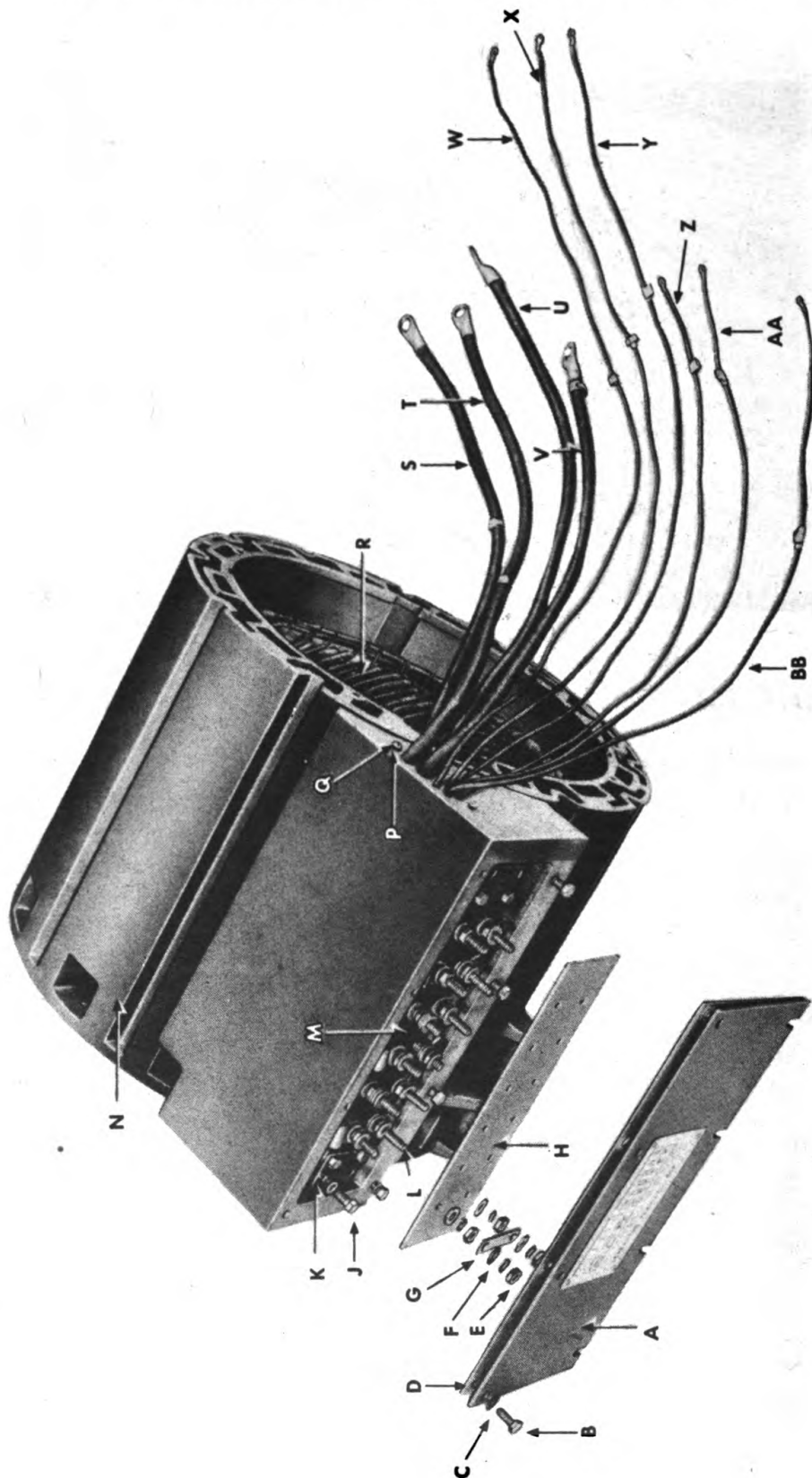
85. ASSEMBLY.

a. Assemble Housing and Stator Assembly (fig. 168).

(1) Position two pieces of insulation between sides of housing and stator at rear end of assembly. Move insulation as necessary to protect stator leads from housing.

(2) Slide metering current transformer (fig. 167) over stator lead wires "A" and "2A." Slide other metering current transformer

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78438

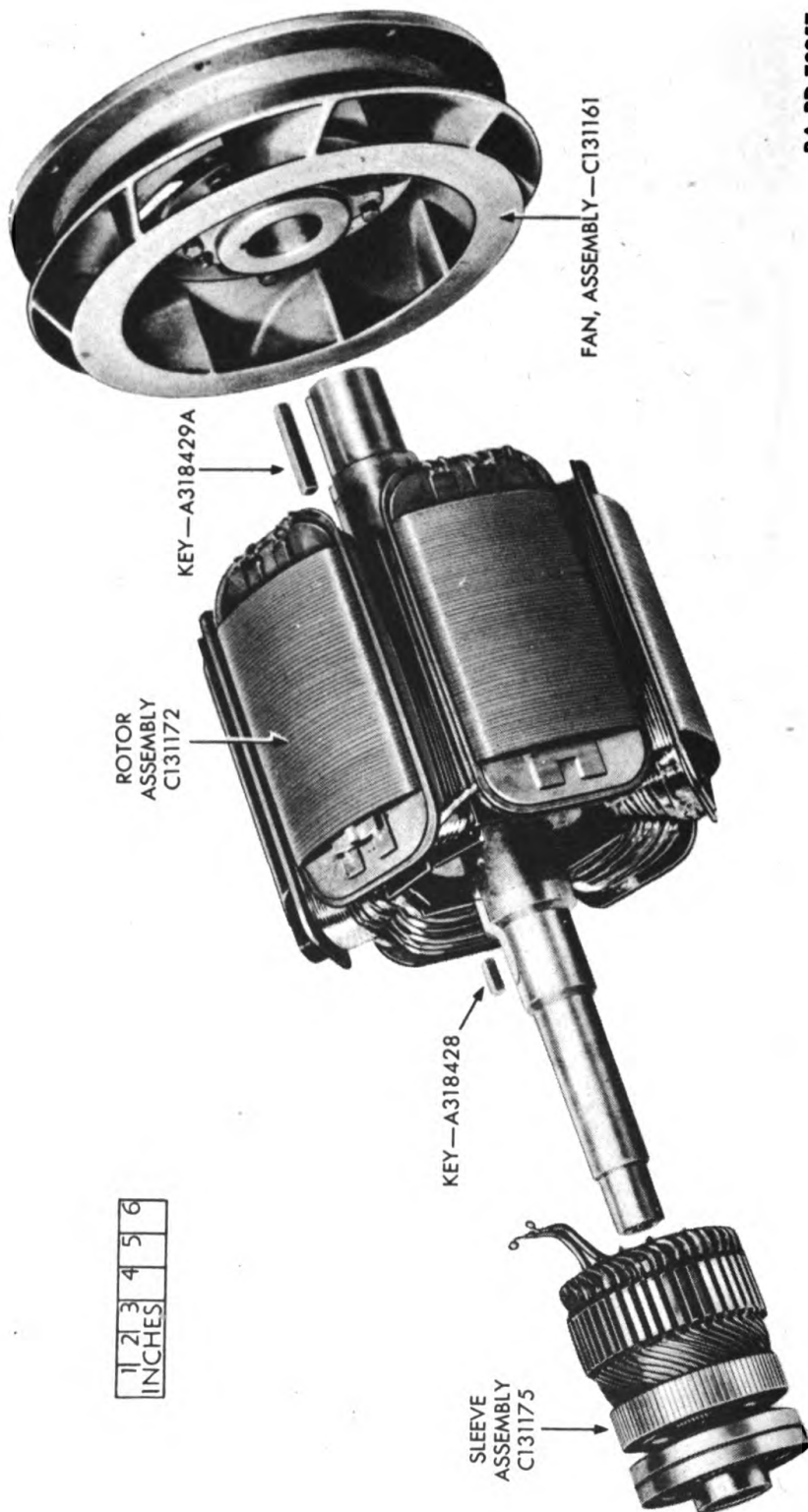
Figure 168—Housing and Stator Partially Disassembled

A-C GENERATING SYSTEM

RA PD 78438A

- | | |
|---|--|
| A—COVER—A318394 | P—SPACER—A319025 |
| B—BOLT—BANX1CA-2 | Q—SCREW—BCNX2CE-2 |
| C—WASHER—BECX1K | R—STATOR, ASSEMBLY—D83371 |
| D—GASKET—A318395 | S—WIRE, ASSEMBLY—B271224B |
| E—NUT, jam, hv., hex., s-fin.,
S., zn-pltd., $\frac{3}{8}$ -16NC-2 | T—WIRE, ASSEMBLY—B271224A |
| F—WASHER—BEBX1BK-14 | U—WIRE, ASSEMBLY—B271224D |
| G—LINK—A318388 | V—WIRE, ASSEMBLY—B271224C |
| H—PLATE—B270753 | W—WIRE, current transformer to
terminal block "3," assembly |
| J—SCREW, cap, hex-hd., S.,
zn-pltd., $\frac{3}{8}$ -16NC-2 x $1\frac{3}{8}$ | X—WIRE, current transformer to
terminal block "4," assembly |
| K—PLATE—A318392 | Y—WIRE, current transformer to
terminal block "8," assembly |
| L—SCREW, special, hex-hd., S., zn-pltd.,
$\frac{3}{8}$ -16NC-2 x $2\frac{3}{4}$, thd. full lgh. | Z—WIRE, ASSEMBLY—B271225C |
| M—BLOCK—B181607 | AA—WIRE, ASSEMBLY—B271225B |
| N—HOUSING—D83376 | BB—WIRE, ASSEMBLY—B271225A |

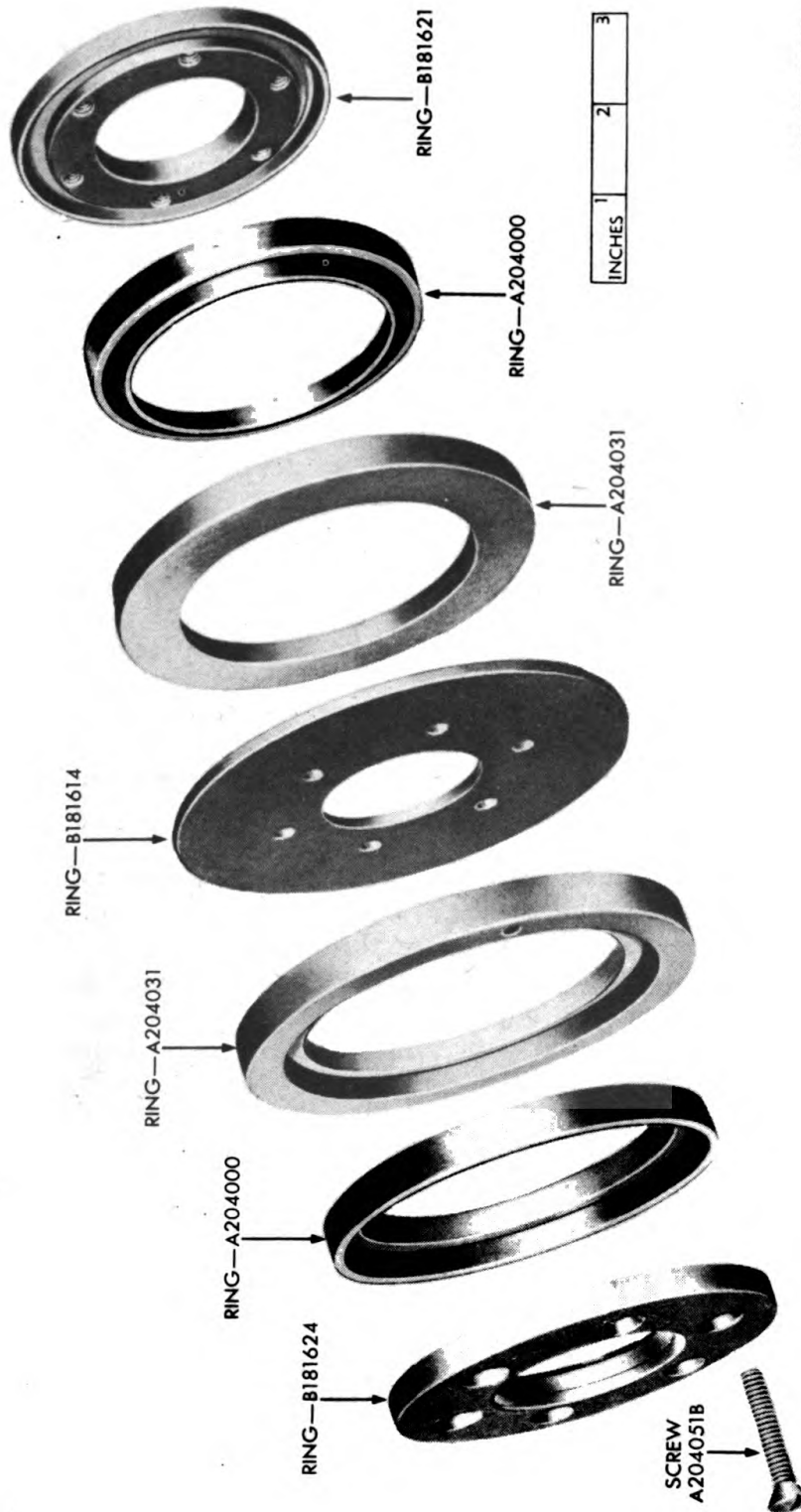
Legend for Figure 168—Housing and Stator Partially Disassembled



RA PD 78357

Figure 169—Rotor Disassembled

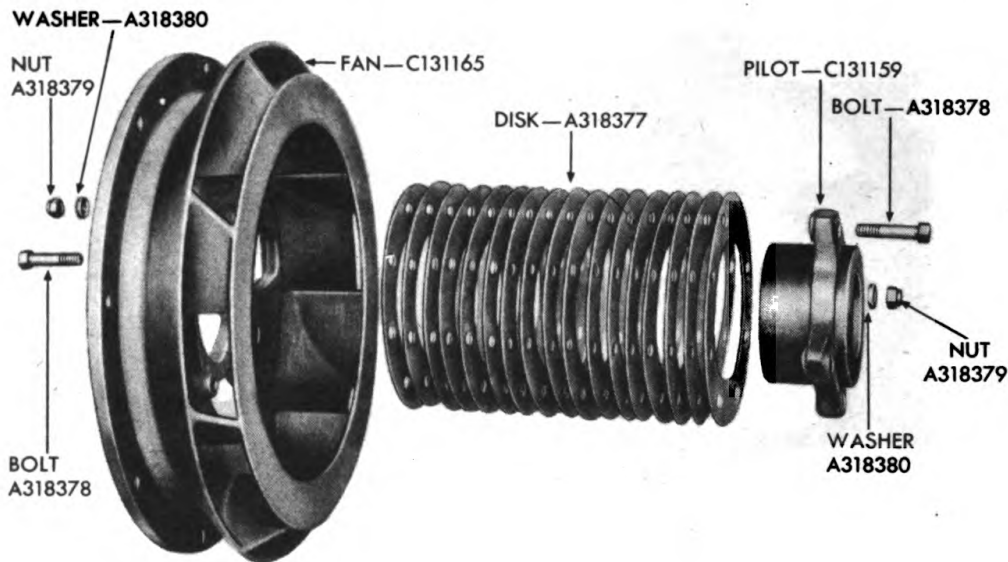
A-C GENERATING SYSTEM



RA PD 78299

Figure 170—Slip Rings Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78382

Figure 171—Front Fan Disassembled

over stator lead wires "C" and "2C." Insert generator lead wires "A," "B," "C," and "O" into position through wire exit hole in housing. Work metering current transformer wires out through wire exit hole in housing.

(3) Place a mounting plate in position on end of generator terminal box base plate. Install the eight flat washers, two bolts, two lock washers, and two nuts which secure the plates together. Similarly install remaining mounting plate on other end of terminal base plate. Position the two U-shaped copper links on rear of plate so they connect the three "O" terminal bolts. Insert "O" terminal bolts through holes in copper links and through "O" holes of plate. Slide a flat washer onto all remaining terminal bolts. Insert remaining terminal bolts into terminal bolt holes from rear of plate. Position plate within housing. Work lug of stator lead wire "2A" onto "2A" terminal bolt and install flat washer, lock washer, and nut. Similarly connect stator lead wires "1A," "2B," "1B," "2C," "1C," and "O" to their respective terminal bolts. Similarly connect generator lead wires "A," "B," "O," and "C" to their respective terminal bolts. Force terminal plate back into position within housing. Install the four lock washers and cap screws which attach terminal plate to housing. Shim all terminal bolts with flat washers as necessary to provide an even backing for terminal designation plate. Slide designation plate onto terminal bolts. Install flat washer, lock washer, and nut on each terminal bolt. Connect links with lock washers and nuts. Position of links is governed by output voltage desired (par. 87 a and b). Position terminal box

A-C GENERATING SYSTEM

cover on housing. Install the eight lock washers and cap screws which attach cover.

(4) Fill wire exit hole with sealing compound composed of a thick mixture of asbestos flour and varnish.

b. Assemble Rotor Assembly (fig. 169).

(1) Assemble and install slip rings as follows (fig. 170): Position an insulating ring in each slip ring. Place separator between slip rings. Position end rings on insulating rings. Install the six screws which hold the assembly together. Press assembly onto exciter armature sleeve. Solder on revolving field lead wire to each slip ring.

(2) Tap key into keyway in rotor shaft. Aline keyways of shaft and exciter armature sleeve. Press armature onto shaft. Connect each revolving field coil lead wire to coil lead with stove bolt and nut. Solder nut to bolt. Paint connections with glyptal synthetic paint. Protect wires with insulation and clamp to shaft sleeve with clamp and screws provided for the purpose.

(3) Tap key into keyway on front end of rotor shaft. Heat flexible coupling spider and press onto shaft over key.

(4) Press bearing onto rear end of shaft. Be sure to install bearing so removable snap ring and retainer are to rear.

c. Assemble Front Fan (fig. 171).

(1) Position the 17 steel disks which make up flexible coupling on front fan.

(2) Install the four bolts, washers, and special nuts which attach disks to fan.

d. Assemble Brush Holder Assembly.

(1) SLIP RING BRUSH HOLDER.

(a) On screw BCNX2CH-2, position bushing A204005, lever B181040, spring A204067, and washer A204003.

(b) Install screw into screw hole in holder B178783, and install nut A204004 on screw.

(c) Similarly assemble the three remaining holders.

(d) If new holders B178783 are used, tap threads in brush lead screw holes with a No. 6-32 by $\frac{3}{16}$ -inch self-tapping screw.

(2) EXCITER BRUSH SPRING BRACKETS.

(a) On screw BCNX2CH-2 position bushing A204005, arm B178782, spring A204067, and washer A204003.

(b) Install screw into screw hole in holder B178779, and install nut A204004 on screw.

(c) Repeat steps (a) and (b), above, to assemble the remaining three brackets.

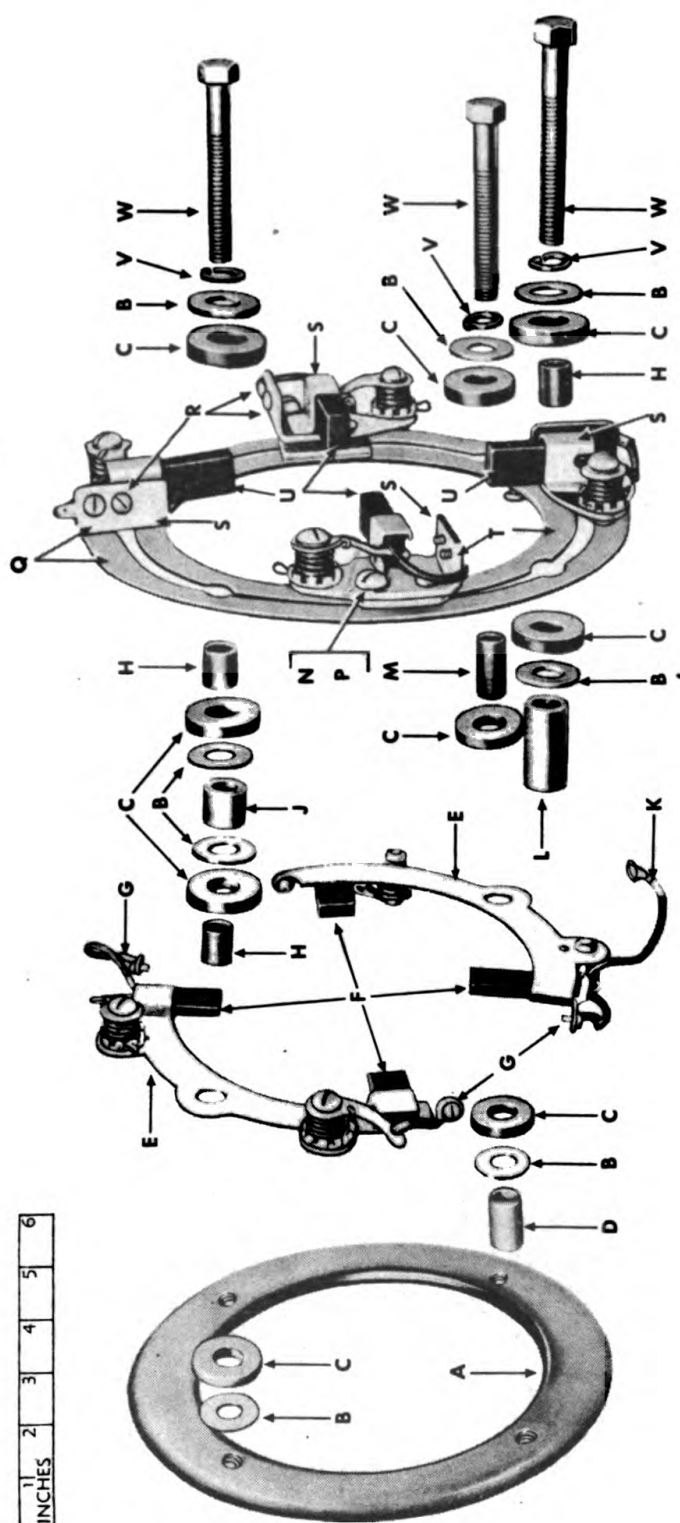


Figure 172—Brush Holder Disassembled

A-C GENERATING SYSTEM

NA PD 78208A

- | | |
|---|-------------------------------------|
| A —RING—A204015 | L —SPACER—A204053 |
| B —WASHER—BEBX2D-2 | M —BUSHING—A204056 |
| C —WASHER—A204045 | N —SCREW—BCNX2CC-2 |
| D —SPACER—A204054 | P —WASHER—BECX1G |
| E —HOLDER, ASSEMBLY—B178787 | Q —RING, ASSEMBLY—B178891 |
| F —BRUSH—B178789 | R —SCREW—BCXX3EA-14 |
| G —SCREW, SELF-TAPPING, BDG-HD., S.,
TN-PLTD., NO. 6 (.138)-32NC-2 x 1/4 | S —BRACKET, ASSEMBLY—B178812 |
| H —BUSHING—A204046 | T —HOLDER, ASSEMBLY—B178813 |
| J —SPACER—A204055 | U —BRUSH—B178788 |
| K — <div style="display: inline-block; vertical-align: middle;"> <div style="display: inline-block; vertical-align: middle;">WIRE, SGLE-COND.,
NO. 12 x 4 1/2 LONG</div> <div style="display: inline-block; vertical-align: middle; margin-left: 5px;"> <div style="border-left: 1px solid black; height: 1em; margin-bottom: 2px;"></div> <div style="border-left: 1px solid black; height: 1em; margin-bottom: 2px;"></div> <div style="border-left: 1px solid black; height: 1em;"></div> </div> </div> | V —WASHER—BECX2K-2 |
| | W —SCREW—BCAX1CK-2 |

Legend for Figure 172—Brush Holder Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(3) INSTALL EXCITER BRUSH SPRING BRACKETS (fig. 172).

(a) Place two exciter brush spring brackets in position on inner ring holder B178813, and attach each with two lock washers and screws.

(b) Similarly install the two remaining exciter brush spring brackets on outer ring B178891.

(4) Place base ring (A)* flat on bench, beveled side up.

(5) On cap screw (W), place lock washer (V), flat washer (B), fiber washer (C), fiber bushing (H), fiber washer (C), flat washer (B), steel spacer (J), flat washer (B), fiber washer (C), fiber bushing (H), brush holder assembly (E), fiber washer (C), and flat washer (B). Start screw into screw hole in base ring (A).

(6) On another cap screw (W), place lock washer (V), flat washer (B), fiber washer (C), fiber bushing (M), fiber washer (C), brush holder assembly (E), fiber washer (C), flat washer (B), and steel spacer (D). Start cap screw into screw hole in base ring (A) opposite screw hole used in step (5), above.

(7) With base ring (A) still flat on bench, carefully remove cap screw installed in step (5), above, with three washers (V, B, and C) on cap screw. This leaves fiber bushing (H), two washers (C and B), steel spacer (J), two washers (B and C), and fiber bushing (H) in place on base ring (A).

(8) Hook outer ring (Q) over cap screw (W) installed in step (6), above. Turn ring so brush holder is to left of screw. Be sure to place ring between the two top fiber washers (C) nearest head of screw. Rest other side of ring on fiber washer (C) in place over screw hole on other side of base ring (A).

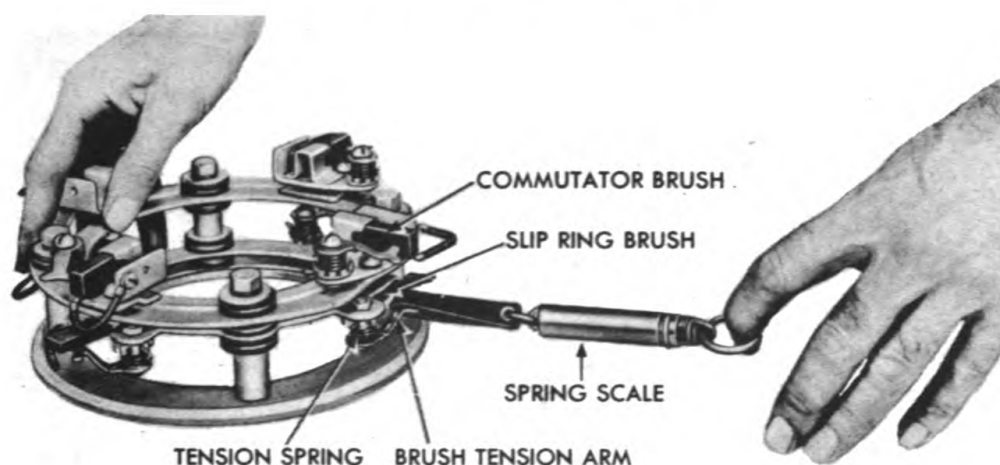
(9) Insert inner ring holder assembly (T) between two top fiber washers (C) on cap screw (W) installed on base ring (A). Arrange ring holder assembly so brush brackets are on top and one-quarter of circumference from brush brackets on outer ring (Q). Rest other side of ring holder assembly on fiber washer (C) in place over screw hole on other side of base ring (A).

(10) Insert cap screw (W) with three washers (V, B, and C), which were removed in step (7), above, between outer ring (Q) and inner ring holder (T) and through washers, bushings, and spacers left in position in step (7), above. Tighten screw securely into base ring (A).

(11) On another cap screw (W), place lock washer (V), flat washer (B), fiber washer (C), and fiber bushing (H). Place screw through space between outer ring assembly (Q) and inner ring holder assembly (T). On end of cap screw, place fiber washer (C), flat washer (B), and steel spacer (L). Tighten screw in base ring (A).

*Refer to figure 172.

A-C GENERATING SYSTEM



RA PD 78506

Figure 173—Measuring Brush Spring Tension

(12) Repeat step (11), above, to install remaining cap screw (W).

(13) Tighten cap screw (W) installed in step (6), above.

(14) Place a brush (U) in each of the four exciter brush spring bracket assemblies with brush turned so lead wire is on side of brush adjacent to outer ring assembly (Q). Place tension arm against side of brush near top of brush so brush is held up in holder. Connect lead wire from each brush with screw in outer hole on each holder.

(15) Place a brush (F) in each of two guides on each of the two slip ring brush holders, with brush turned so brush lead wire is adjacent to screw hole. Place tension lever against side of brush near top so brush is held up in guide. Attach brush lead wires to holders with screws provided for the purpose (fig. 172).

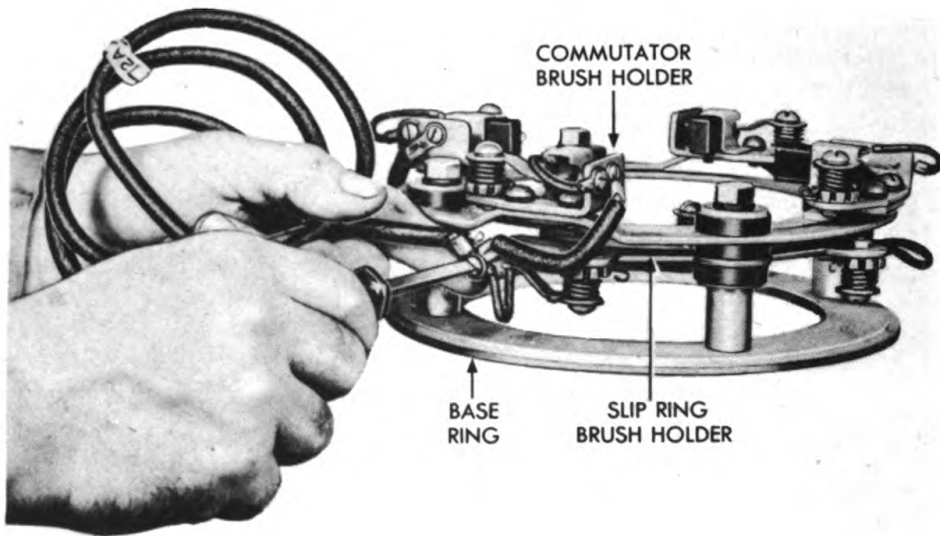
(16) Measure tension of each brush tension arm with a spring scale (fig. 173). Hook scale to end of arm, pull scale, and observe reading. Move end of tension springs to right or left to decrease or increase tension. Adjust slip ring brushes to 8-ounce tension and commutator brushes to 12-ounce tension.

(17) Turn assembly so slip ring brush holder (E) assembled closest to ring (A) faces you. Connect wire from exciter brush holder over right-hand end of commutator brush holder to slip ring brush holder (fig. 174).

(18) Turn assembly so slip ring brush holder farthest from base ring faces you. Connect wire from commutator brush holder over left end of slip ring brush holder to slip ring brush holder. Also connect generator lead wire "2A" to slip ring brush holder (fig. 174).

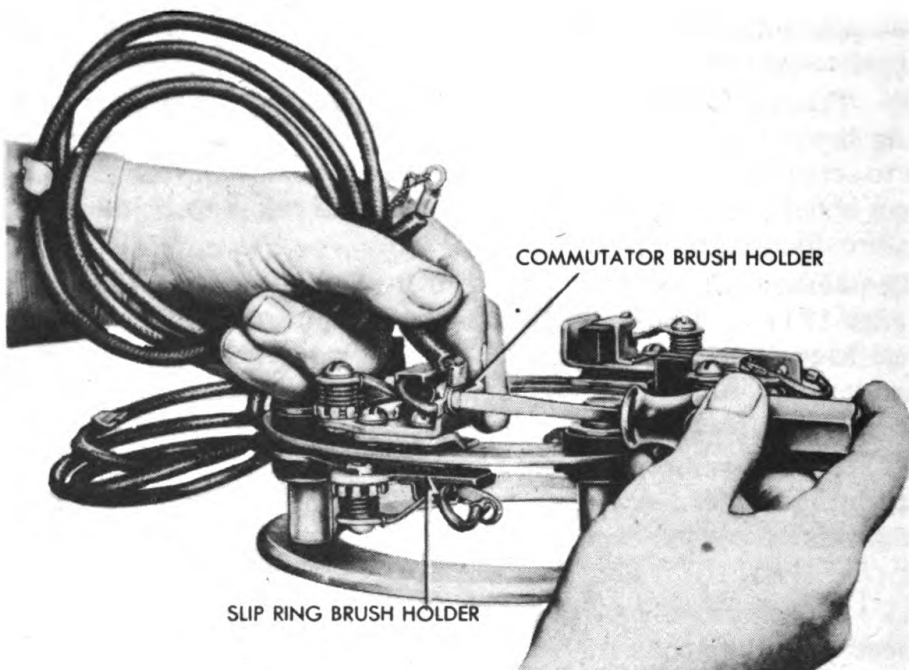
(19) Connect generator lead wire "1A" to commutator brush holder over right end of slip ring brush holder (fig. 175).

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78508

Figure 174—Connecting Generator Lead Wire "2A"



RA PD 78548

Figure 175—Connecting Generator Lead Wire "1A"

A-C GENERATING SYSTEM

e. Assemble Exciter Field and Brush Holder Support Bracket (fig. 176).

(1) Position brush holder assembly in exciter field and brush holder support bracket. Turn holder so generator lead wire "A2" point of attachment is adjacent to left-hand set screw. Tighten the two set screws which secure holder to bracket.

(2) Wrap pole piece large insulator around each pole piece and insert pole pieces into exciter field coils. Work a pole piece small insulator under each shoulder of pole pieces between coils and pole pieces. Position coils in bracket with coils which are not connected to each other to right-hand side of bracket. Install pole piece screws just tight enough to hold coils in place. Work the four bracket insulators between coils and bracket, but not under pole pieces. Tighten pole piece bolts securely (fig. 177).

(3) Connect short lead wire from exciter field coils to lower right-hand commutator brush holder B178779.

(4) Work long exciter field coil lead wire out through wire exit hole in bracket. Work generator lead wires "2A" and "1A" out through same hole. Fill hole with a sealing compound of 55 percent asbestos flour and 45 percent shellac varnish by weight.

f. Install Rotor (fig. 149).

(1) Insert two bolts through opposite bolt holes in rotor spider and attach a chain loop to bolts. Attach a hoist to chain loop and lift rotor.

(2) Place stator and housing assembly on its back end on blocks under hoist.

(3) Lower rotor into position within stator and housing. Tip generator over to horizontal position.

g. Install Front Fan (figs. 171 and 176). Position fan with disks attached to it to pilot which is sweated to rotor shaft. Install the four bolts, washers, and special nuts which attach laminated coupling disks to shaft.

h. Install Exciter Field and Brush Holder Support Bracket and Rear Fan (fig. 176).

(1) Check all brushes to be sure they are lifted up in holders so tension levers hold them there.

(2) Position bracket on rear of generator, making certain that bearing seats properly (flush with outside). Install the eight lock washers and cap screws which attach bracket to housing.

(3) Reach through brush cover openings and lift each brush tension lever sufficiently to free brushes. Push brushes into contact with commutator or slip rings. Install brush covers.

RA PD 78436

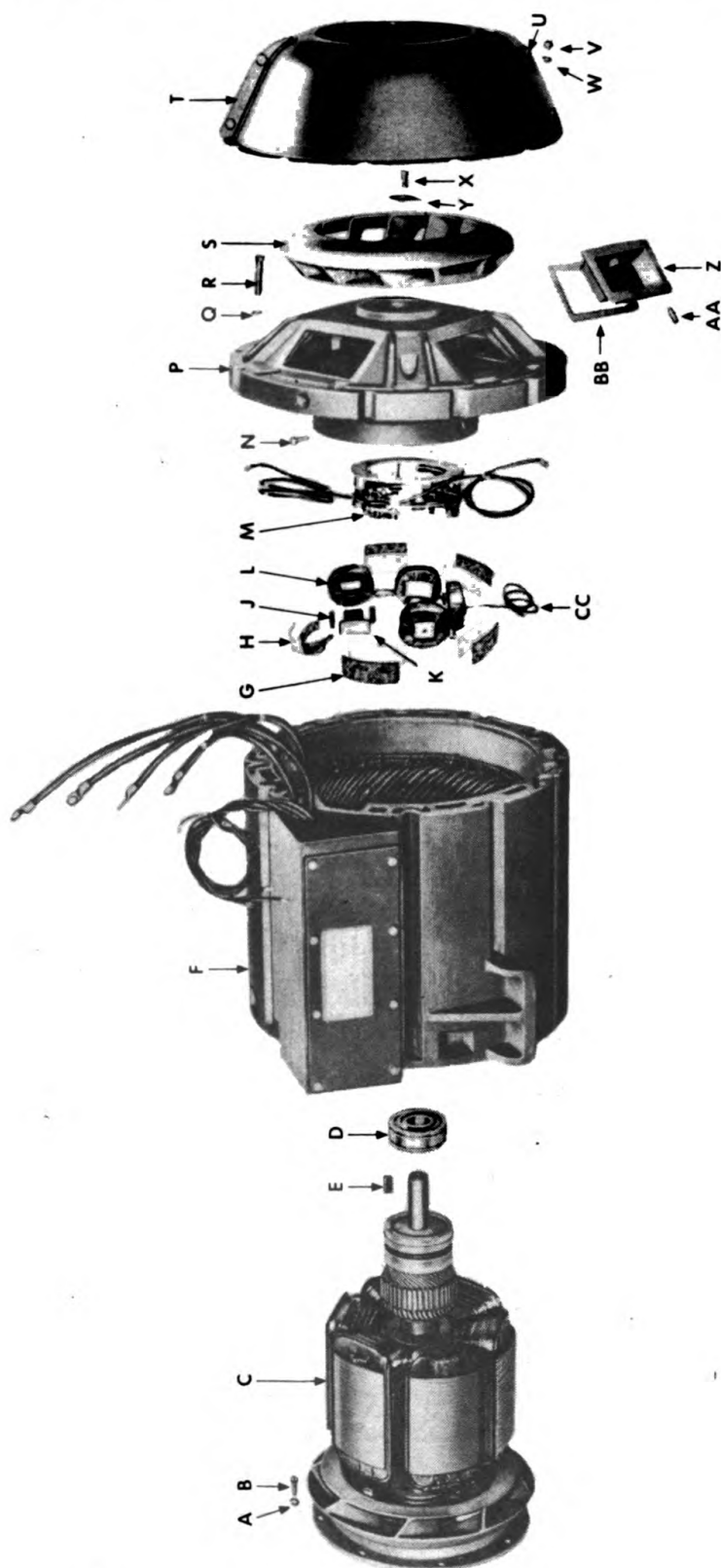


Figure 176—A-C Generator—Partially Exploded View

A-C GENERATING SYSTEM

RA PD 78436A

A—WASHER—BECX1M	Q—WASHER—BECX1L
B—SCREW, cap, hex-hd., S, zn-pltd., 1/2-13NC-2 x 1 3/8	R—BOLT—BANXIDM-2
C—ROTOR, ASSEMBLY—C131184	S—FAN—C131162
D—BEARING—NH-3610-J	T—GUARD, main generator rotor fan
E—KEY—A318428	U—NUT—B8CX1C-2
F—HOUSING, main generator, assembly	V—BOLT, hex-hd., s-fin., alloy-S, zn-pltd., 3/8-16NC-2 x 9/16
G—INSULATOR—HBC-40J-66	W—WASHER—BECX1K
H—INSULATOR—HBC-40J-65	X—SCREW—BCDX1BB-2
J—INSULATOR—A318442	Y—WASHER—A318381
K—PIECE—B181617	Z—COVER—B181610
L—COIL, ASSEMBLY—C131177	AA—SCREW, set, socket-hd., cone-pt., S, 1/2-13NC-2 x 1 1/4
M—HOLDER, ASSEMBLY—D83469	BB—GASKET—A318396
N—BOLT, hex-hd., s-fin., alloy-S, zn-pltd., 3/8-16NC-2 x 1 3/8	CC—WIRE, ASSEMBLY—B271223C
P—BRACKET—D83368	

Legend for Figure 176—A-C Generator—Partially Exploded View

ORDNANCE MAINTENANCE—GENERATING UNIT M18

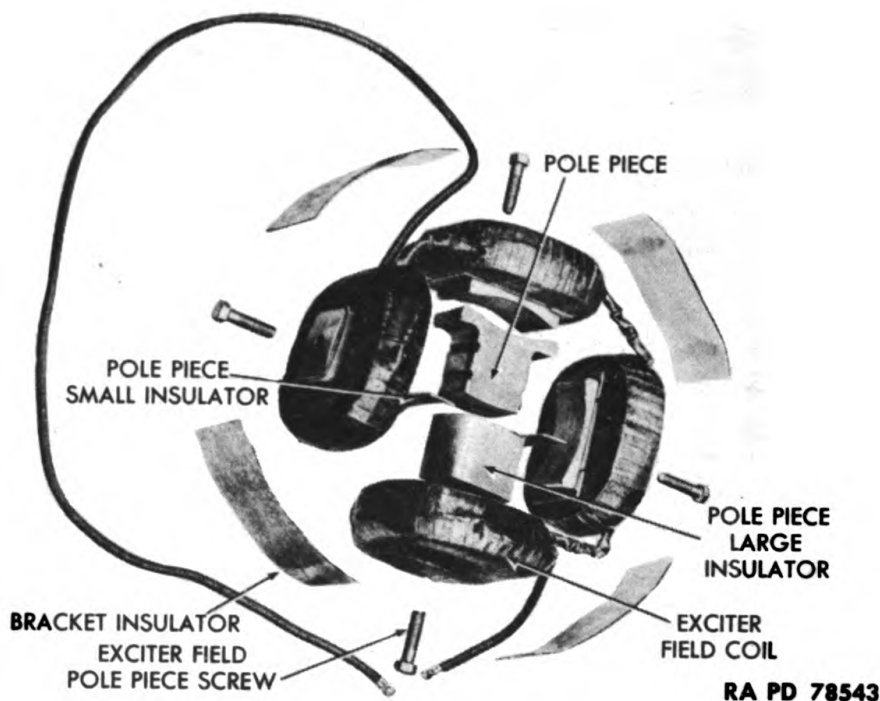


Figure 177—Exciter Field Coil Installation

(4) Tap key into position in keyway on rear of rotor shaft. Tap rear fan into place on end of shaft over key. Install special washer and screw which secure rear fan to shaft.

86. INSTALLATION.

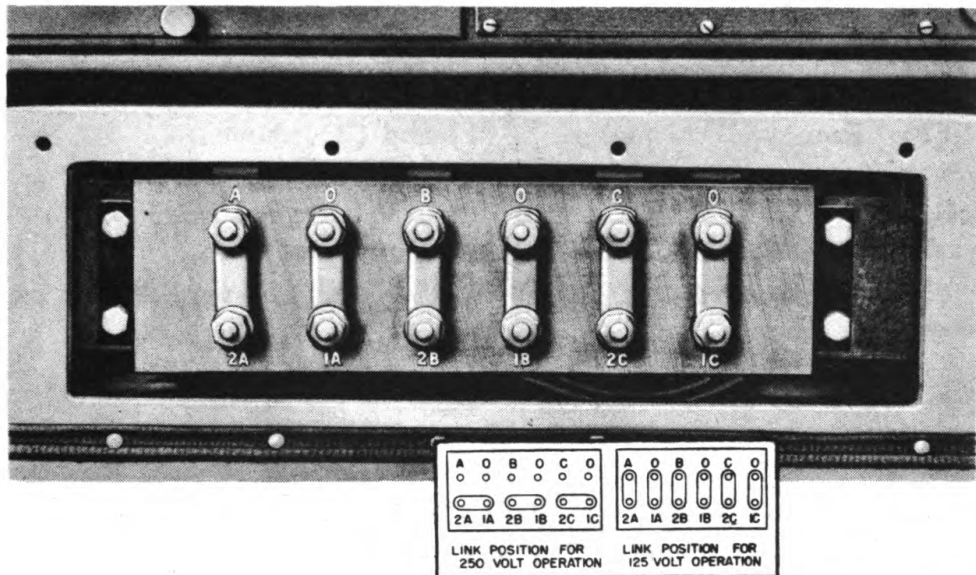
a. Lower generator into position on unit behind engine and inch ahead until in position against engine (fig. 143).

b. Hand-crank engine to align prick-punch marks on flywheel and fan (fig. 142). If prick-punch marks were not made at time of removal, it will be necessary to crank engine until screw holes line up.

c. Install the eight lock washers and screws which attach generator fan to engine flywheel.

d. Remove hoist and install the 12 lock washers and screws which attach engine bell housing to generator housing. Long cap screw goes in top center hole.

e. Install the four special washers, cap screws, lock washers, and nuts which secure generator to main frame.

A-C GENERATING SYSTEM

CHANGE-OVER DIAGRAM

RA PD 78574

Figure 178—Generator Terminal Box

f. Position the two bell housing cover plates over handholes on bell housing. Install the eight lock washers and cap screws which attach each plate to bell housing.

g. Place fan guard in position on rear end of generator. Install the lock washers and screws which secure guard to generator.

h. Remove blocking placed between engine bell housing and frame to support engine.

i. Install rear upright frame, battery and tool box shelf, instrument panel (par. 96), gasoline tank (par. 37 f), both rear side panels, hood, and all four doors.

87. ADJUSTMENTS.

a. **Adjust Unit To Deliver 125-volt Output (fig. 178).**

(1) Remove the eight cap screws and lock washers which attach generator terminal box cover to left side of generator housing. Lift cover from housing.

(2) Remove nuts, lock washers, and links from terminal bolts.

(3) With links, connect terminal bolts "A" and "2A," "O" and "1A," "B" and "2B," "O" and "1B," "C" and "2C," and "O" and "1C." Secure links to terminal bolts with lock washers and nuts.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(4) Attach cover to housing with the eight lock washers and cap screws.

b. Adjust Unit To Deliver 250-volt Output (fig. 178).

(1) Remove links (subpar. a (1) and (2), above).

(2) With links, connect terminal bolts "2A" and "1A," "2B" and "1B," and "2C" and "1C." Secure links to terminal bolts with lock washers and nuts.

(3) Attach cover to housing with the eight lock washers and cap screws.

c. Adjust Voltage Output Slightly. If voltage is "OFF" slightly under load and if check-up reveals no mechanical fault, proceed as follows:

(1) Loosen the two set screws which secure generator brush holder assembly to exciter field and brush holder support bracket.

(2) Turn brush holder counterclockwise (viewed from rear of unit) to lower voltage; clockwise to raise voltage. Tighten set screws and test unit. Repeat adjustment and test until correct under load voltage is obtained.

Section II**POWER RECEPTACLES AND LOAD TERMINAL BOX****88. 200-AMPERE POWER RECEPTACLES.**

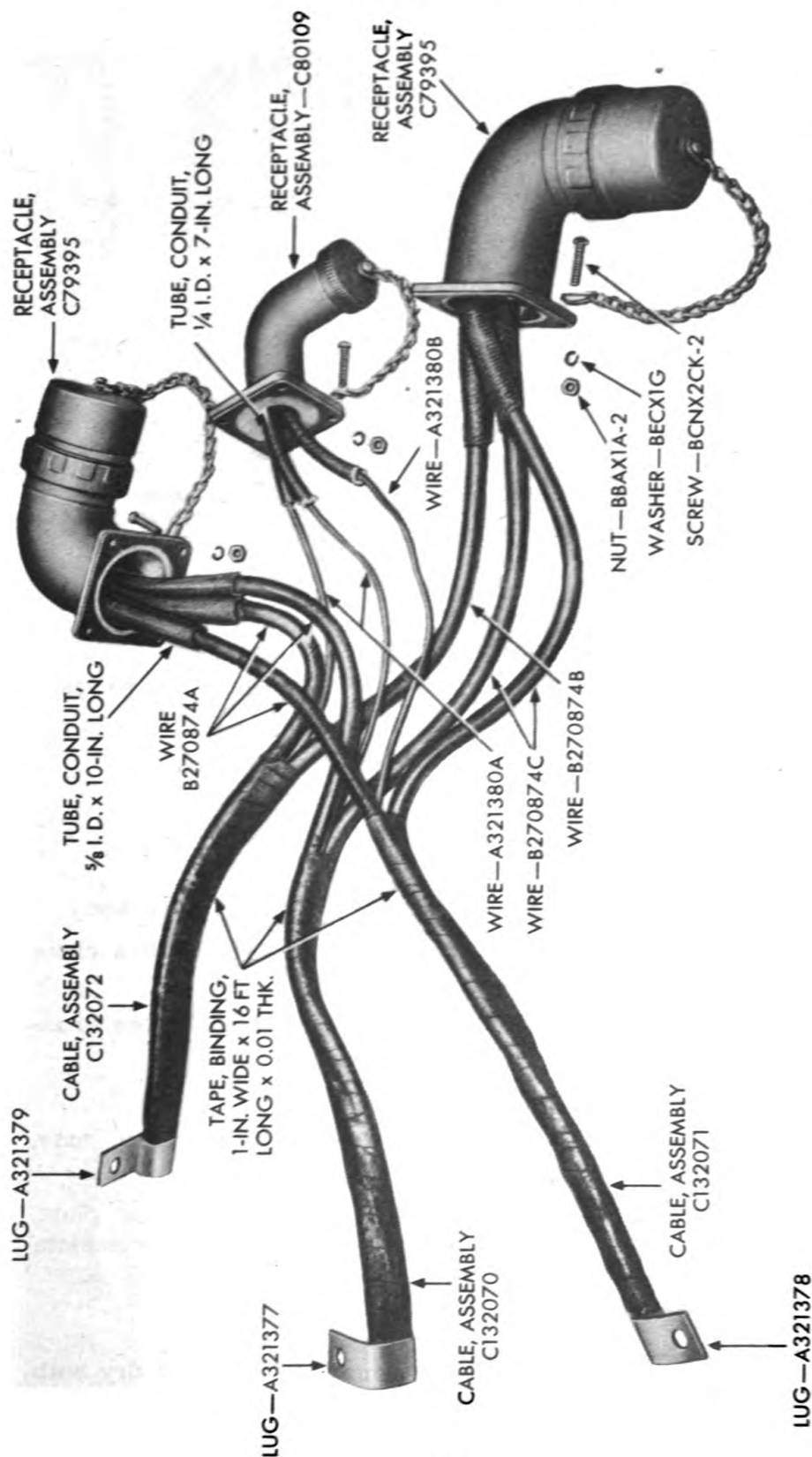
a. Description (figs. 179 and 180). There are two 200-ampere duty three-pole receptacles. Each receptacle body is of elbow type steel construction. Attaching end of receptacle body has a square-shaped flange with four screw holes. The other end has a round nut which attaches a chained cover. The three terminals are secured in the insulation which is housed within body. The assembly is retained by a split ring.

b. Removal (fig. 180).

(1) Remove nut and external tooth lock washer from terminals "A," "B," and "C" on rear of load terminal box. Remove the three cable lugs from "A," "B," and "C" connectors.

(2) Remove four nuts, lock washers, flat washers, and screws which attach each 200-ampere receptacle and the 30-ampere receptacle. Lift the three receptacles from receptacle support panel and bracket.

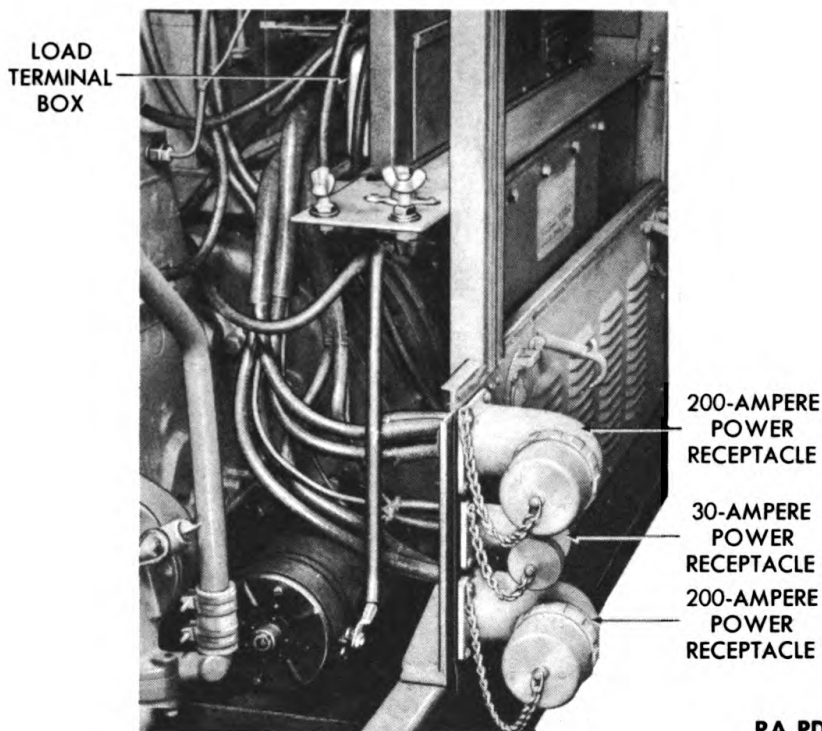
A-C GENERATING SYSTEM



RA PD 78301

Figure 179—Receptacles and Cables Removed From Unit

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78613

Figure 180—Power Receptacles Installed.**c. Disassembly (fig. 181).**

- (1) Remove gasket from bottom of body flange.
- (2) Unscrew round nut from cover and lift cover from body.
- (3) Pull pin which attaches chain to cover and remove chain from cover.
- (4) Remove the four screws which attach the four shoes to inside of round nut. Slip round nut from body.
- (5) Remove molded rubber cover gasket from body.
- (6) Remove split ring which secures insulation within body. Pull insulation from body.
- (7) If necessary to repair terminal wires or insulating plate, unsolder terminals from cable wires, and remove terminals and plate from wires.

d. Inspection and Repair.

- (1) Clean all metal parts in dry-cleaning solvent and dry with cloth. Clean insulation with a wire brush. Examine body, cover, chain, and nut for cracks. Weld or replace if cracked.

RA PD 78203

A-C GENERATING SYSTEM

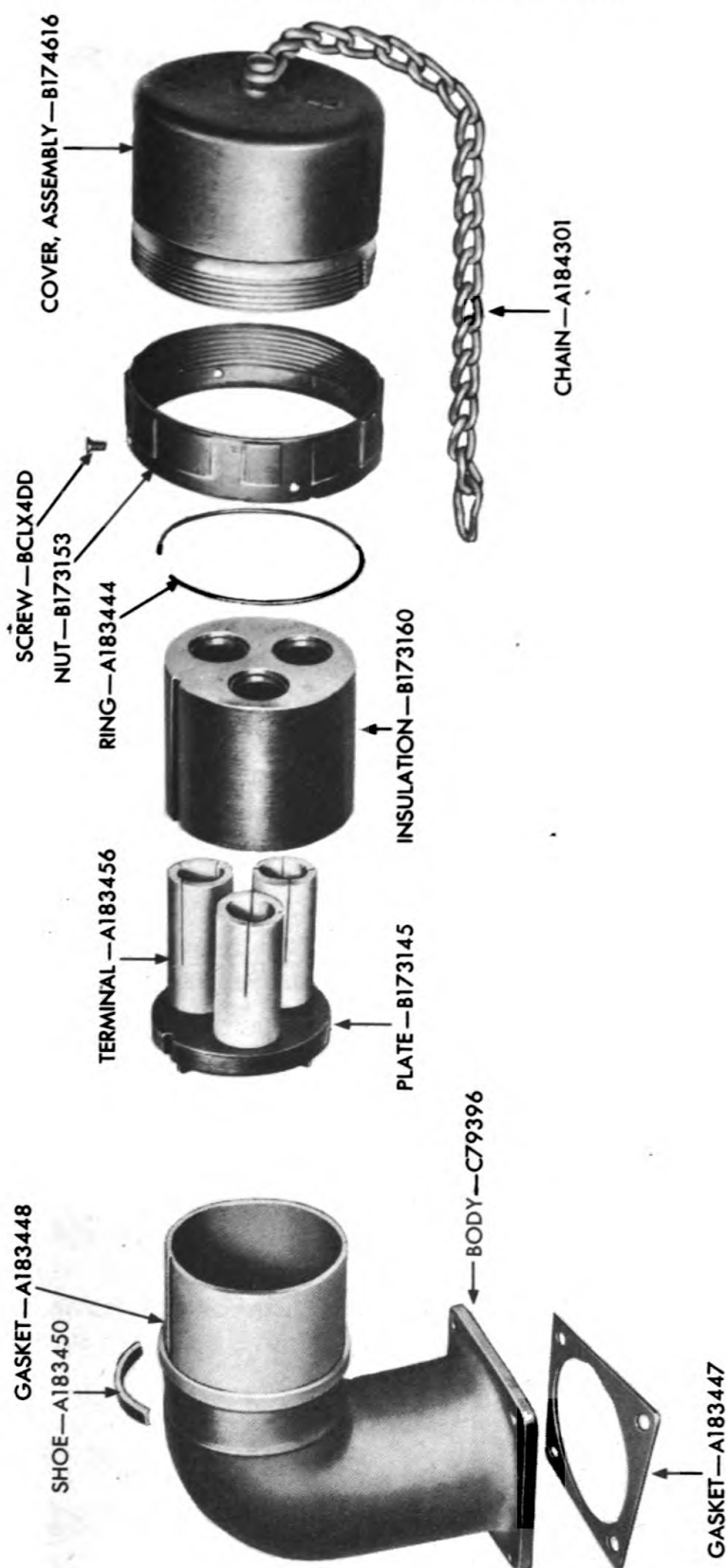


Figure 181—200-ampere Receptacle Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(2) Examine all threads to see if stripped or burred. File off all burs. Replace receptacle if unrepairable.

e. Assembly (fig. 181).

(1) Position cables through body gasket and body. Slide plate onto cables so that cables "A," "B," and "C" project in clockwise rotation. Cable "A" directly to left of alining groove on circumference of plate. Solder terminal to end of each cable.

(2) Slide insulation over terminals. Be sure terminals on cables "A," "B," and "C" are inserted into corresponding holes of insulation. Work wires, plate, terminals, and insulation back into position in body. Install split ring which secures insulation within body.

(3) Position round nut on body. Slide shoe into position within nut. Install screw which holds shoe to nut. Similarly install three remaining shoes.

(4) Work cover gasket into position on body.

(5) Position chain on cover and drive in pin which attaches chain to cover. Peen pin. Position cover on body and screw round nut onto cover fingertight.

f. Installation (fig. 180).

(1) Insert cables through hole in receptacle support panel and bracket. Place the two 200-ampere and one 30-ampere receptacles in position on receptacle support panel and bracket. Install the four plain washers, screws, lock washers, and nuts which attach each receptacle.

(2) Connect cable "A" to terminal "A" on rear of load terminal box with external tooth lock washer and nut. Similarly connect cable "B" to terminal "B" and cable "C" to terminal "C."

89. 30-AMPERE POWER RECEPTACLE.

a. Description (figs. 179 and 180). The 30-ampere power receptacle has a body of elbow type steel construction. Attaching end of receptacle body has a square-shaped flange with four screw holes. On the other end is a threaded edge which attaches a chained cover. The three terminals are secured in an insulating retainer which is housed within body. The assembly is held in the body by a split ring.

b. Removal. See paragraph 88 b.

c. Disassembly (fig. 182).

(1) Remove gasket from bottom of body flange and screw cover from body.

(2) Remove split ring which holds retainer within body. Force retainer terminals and insulator clear of body.

A-C GENERATING SYSTEM

RA PD 78205

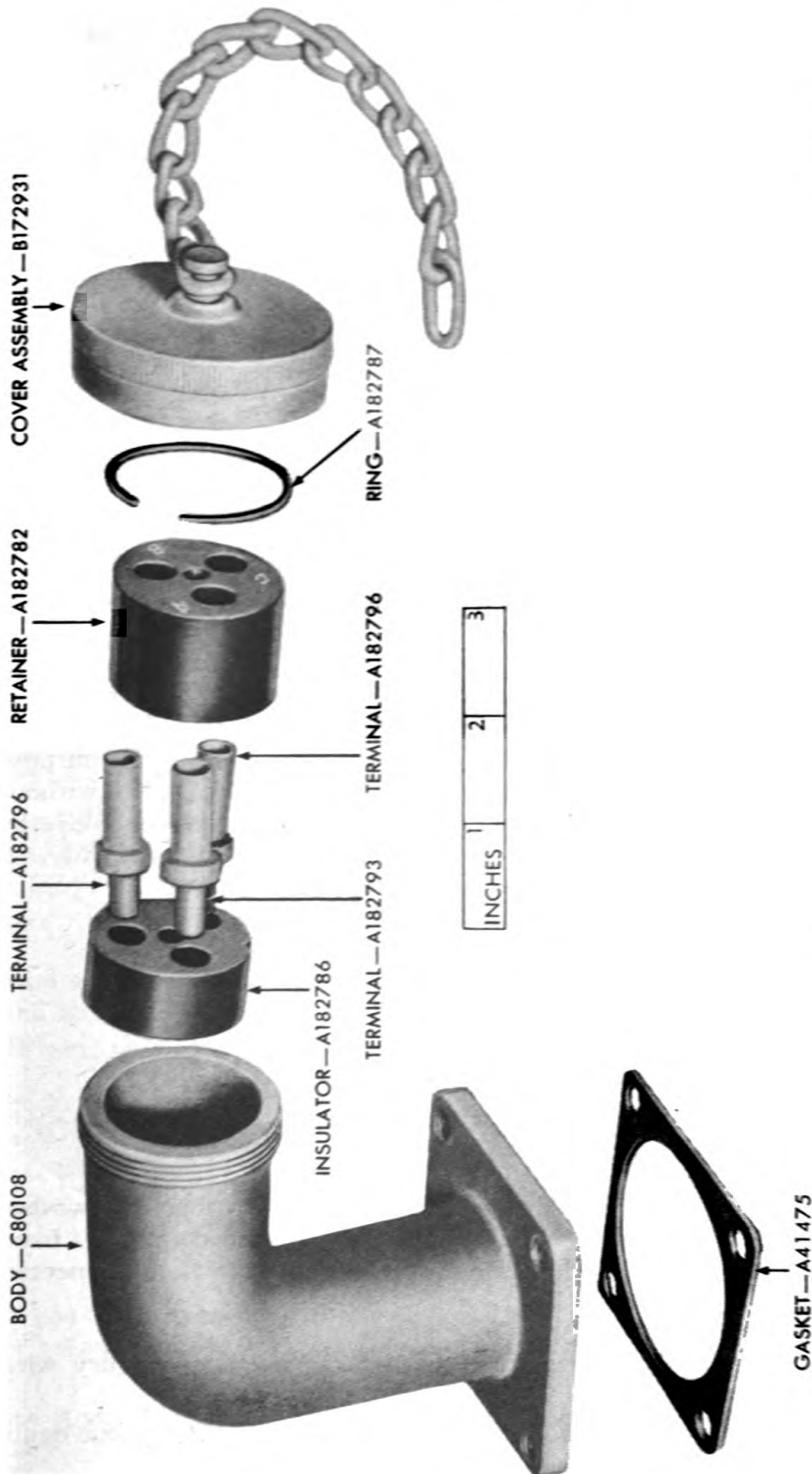


Figure 182—30-ampere Receptacle Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(3) If necessary to replace terminals, insulator, or wires, unsolder terminals from cable wires, and remove terminals and plate.

(4) Pull pin which attaches chain to cover.

d. Inspection and Repair. See paragraph 88 d.

e. Assembly (fig. 182).

(1) Insert cables into position through body gasket, body, and insulator. Be sure to set wires "A," "B," and "C" in clockwise rotation through insulator. Solder terminal to end of each wire.

(2) Position terminal of wire "A" through hole marked "A" of retainer, wire "B" through hole "B," and wire "C" through hole "C." Work wires, insulator, terminals, and retainer back into body. Install split ring which holds retainer within body.

(3) Position chain on cap, and install and peen pin which holds chain to cap. Screw cap onto body.

f. Installation. See paragraph 88 f.

90. LOAD TERMINAL BOX.

a. Description (fig. 183). The load terminal box is of rectangular-shaped sheet metal construction. Located at the lower left-hand corner of the instrument panel, it houses four connectors. Its purpose is to make possible use of the unit to operate equipment without proper sockets to fit the power receptacles. It also enables the operator to reach "O" circuit. The interior of the box is readily accessible through a door on the instrument panel.

b. Removal (fig. 183).

(1) From each terminal on rear of load terminal box, remove nut, external tooth lock washer, cable lug, bus bar lug, and bus bar.

(2) Remove the four screws which attach lid to box on front of instrument panel. Lift lid from panel.

(3) Remove the five nuts, washers, and screws which attach box to instrument panel. Lift box from panel.

c. Disassembly (fig. 184). Remove nut, flat washer, and washer insulator from rear of each connector. Pull the four connectors from box. Remove insulating bushing and insulator from each connector.

d. Inspection and Repair.

(1) Wash metal parts with dry-cleaning solvent and dry with cloth.

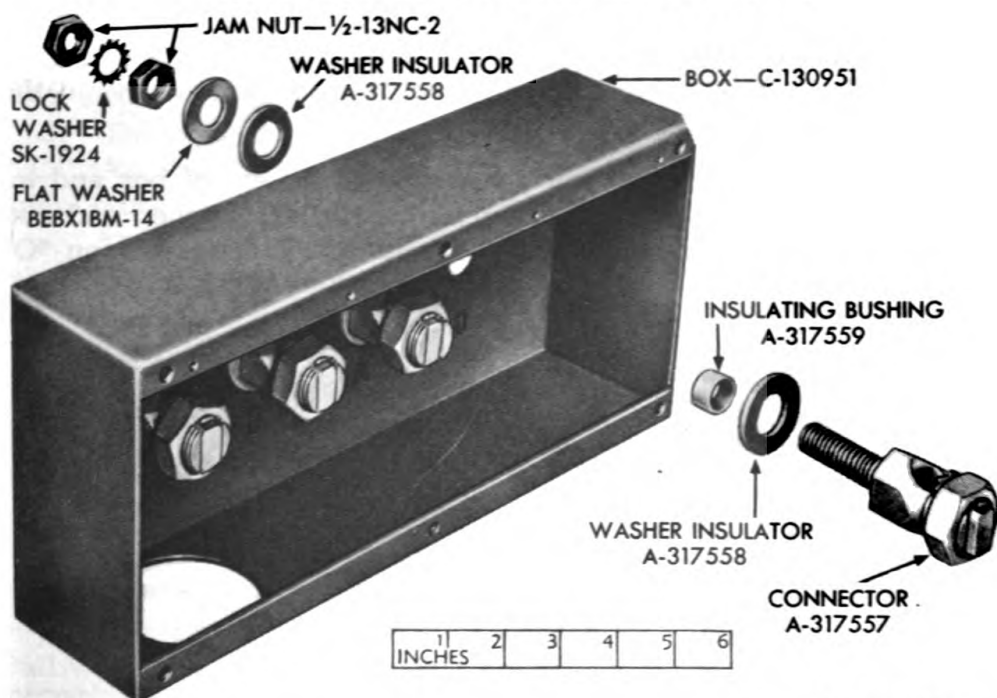
(2) Examine sheet metal for dents and cracks. Bump out dents and weld cracks, if possible.

A-C GENERATING SYSTEM



RA PD 78512

Figure 183—Load Terminal Box Installed



RA PD 86677

Figure 184—Load Terminal Box Disassembled

(3) Examine fiber bushings and washers to see if any are broken or grease soaked.

(4) Inspect all connectors, screws, nuts, and metal washers to see if any are burred, bent, or broken. Examine threads of threaded parts. File off all burs.

ORDNANCE MAINTENANCE—GENERATING UNIT M18**e. Assembly (fig. 184).**

(1) Slide washer insulator and insulating bushing onto each connector and place connectors in position in box. On back of each connector, install washer, insulator, flat washer, and nut.

(2) Position upper half of hinge on door. Drive hinge pin through hinge. Screw knurled head screw (handle) into door.

(3) On terminal "A" on rear of box, install bus bar "A," bus bar lug, receptacle cable "A," external tooth lock washer, and nut.

(4) Similarly connect bus bar "B" and cable "B" to terminal "B," and bus bar "C" and cable "C" to terminal "C."

(5) On terminal "O," install bus bar "O," external tooth lock washer, and nut.

f. Installation (fig. 183).

(1) Position box on instrument panel. Install the five screws, washers, and nuts which secure box to panel.

(2) Position lid on instrument panel in front of box. Install the four screws which attach lid to panel.

(3) Slide "A" bus bar onto "A" terminal on rear of box and install bus bar lug, "A" cable lug, external tooth lock washer, and nut. Similarly connect terminals "B," "C," and "O" (no bus bar on "O" terminal).

CHAPTER 6

INSTRUMENT PANEL

Section I

PANEL

91. DESCRIPTION AND CONSTRUCTION (figs. 186 and 187).

a. The panel is attached to horizontal supports welded to left side center and rear upright frames by means of rubber padded mountings.

b. Except for the fuel gage and starting motor switch, the panel brings together all controls and gages necessary for normal operation and control of the unit.

92. REMOVAL (fig. 185).

a. Remove all four doors, hood, and left rear side panel. For convenience, tool box and battery boxes may be removed.

b. Disconnect a-c generator lead wires "A," "B," and "C" from corresponding terminals of circuit breaker panel.

c. Disconnect a-c generator lead wire "O" from "O" terminal of load terminal box.

d. Disconnect a-c generator lead wires "3," "4," "8," "2A," "2B," "2C," "A2," "A1," and "F" from corresponding terminals of large terminal block.

e. Disconnect power receptacle lead wires "A," "B," and "C" from corresponding terminals of load terminal box.

f. From small terminal block, disconnect "CG" wire (to two-charge regulator), "IGN" wire (to ignition coil), "63" wire (to electric brake receptacle), "61" wire (to battery).

g. Disconnect "B+" wire to starter switch from "B+" terminal of the battery charging ammeter.

h. Disconnect oil pressure gage line from gage.

i. Unscrew nut and remove temperature gage bulb from left rear corner of engine cylinder head.

j. Disconnect throttle and choke control wires from carburetor. Pull wires free of guide bracket welded to front battery box. **CAUTION:** *Do not allow wires to come in contact with battery terminals.*

k. Remove screw, lock washer, and large plain washer from each of the four mountings. Lift panel from unit.

93. DISASSEMBLY (figs. 186 and 187).

a. Remove following assemblies in accordance with instructions in TM 9-617: battery charging ammeter, oil pressure gage, temperature gage, running time meter, frequency meter, voltmeter, 125-

ORDNANCE MAINTENANCE—GENERATING UNIT M18

- A—MOUNTING SCREW
- B—CIRCUIT BREAKER PANEL
- C—LARGE TERMINAL BLOCK
- D—OIL PRESSURE GAGE
- E—BATTERY CHARGING AMMETER
- F—ENGINE TEMPERATURE GAGE
- G—THROTTLE CONTROL
- H—SMALL TERMINAL BLOCK
- J—LOAD TERMINAL BOX
- K—CHOKE CONTROL

RA PD 78617

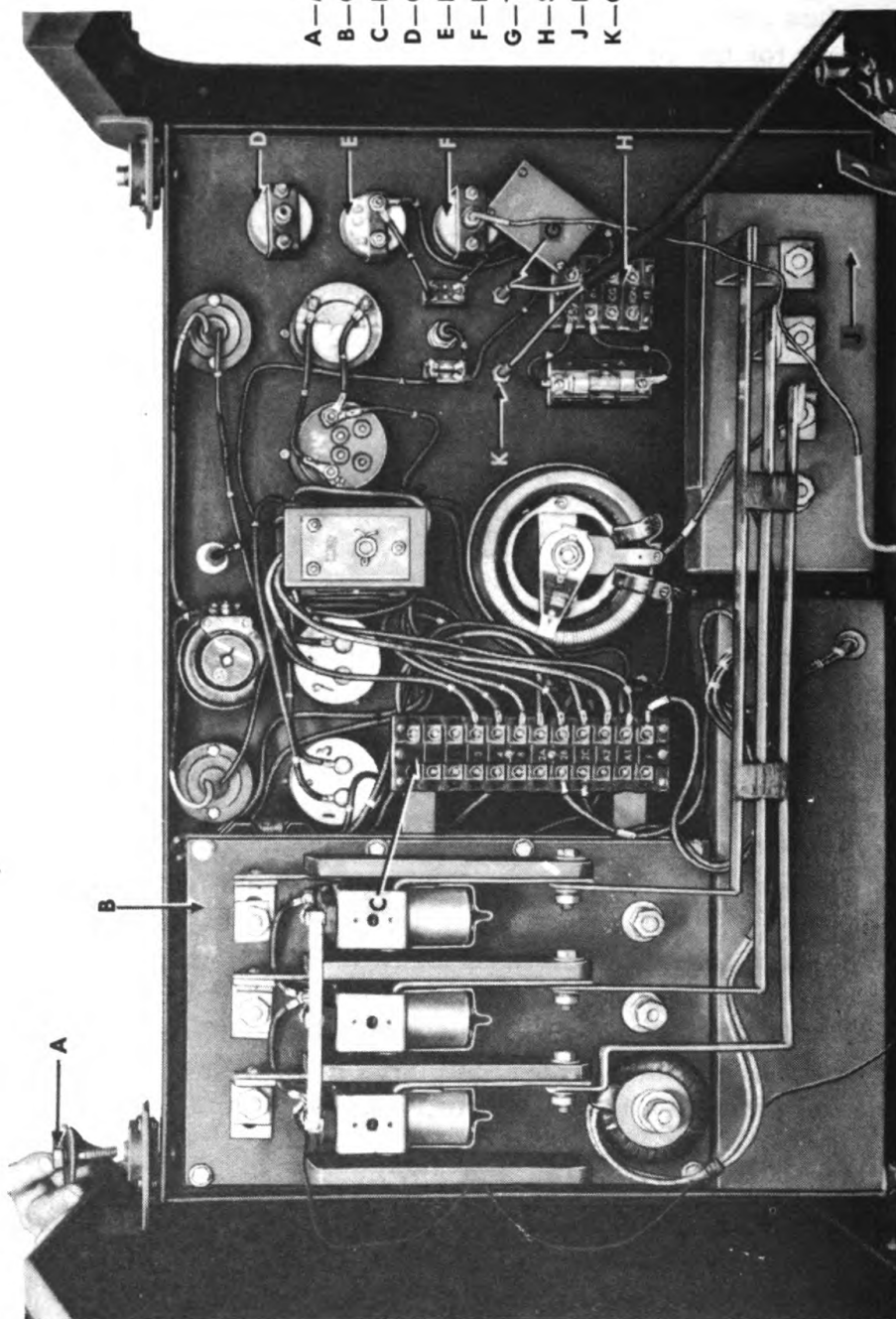


Figure 185—Instrument Panel Removal

INSTRUMENT PANEL

volt ammeter, field rheostat, ignition switch, 125-volt light receptacles, 125-volt light switch, lamp-dimming rheostat, 6-volt light receptacle, 6-volt lightswitch, 6-volt receptacle, throttle control, choke control, and T-slot receptacles.

h. Remove meter switch (par. 104 **h**), circuit breaker panel assembly (par. 108 **h**), voltage regulator (par. 116), and load terminal box (par. 90 **h**).

c. Remove the two nuts and lock washers which secure small terminal block to panel. Remove the two nuts, lock washers, and screws which secure fuse block to panel. Lift terminal block and fuse block from panel.

d. Remove the screws which attach the 10 name and instruction plates to front of panel. Lift plates from panel.

94. INSPECTION AND REPAIR.

a. Inspection. Examine panel to see if it is bent or broken. See if welds have pulled loose.

b. Repair. Straighten panel if bent. Weld broken places and loosened welds. File places smooth after welding.

95. ASSEMBLY (figs. 186 and 187).

a. Position name and instruction plates on front of panel as shown in figure 205. Install screws which hold plates to panel.

b. Place small terminal block and attached fuse block in position on rear of instrument panel at lower front corner. Install the two screws, lock washers, and nuts which attach each block to panel.

c. Install load terminal box (par. 90 **f**), voltage regulator (par. 120), circuit breaker panel assembly (par. 108 **f**), and meter switch (par. 104 **f**).

d. Install following assemblies in accordance with **TM 9-617**: T-slot receptacles, choke control, throttle control, 6-volt receptacle, 6-volt light switch, 6-volt light receptacle, lamp-dimming rheostat, 125-volt light switch, 125-volt light receptacles, ignition switch, field rheostat, 125-volt ammeter, voltmeter, frequency meter, running time meter, temperature gage, oil pressure gage, and 12-volt ammeter.

96. INSTALLATION (fig. 185).

a. Lift panel into position on unit. Aline screw holes in mountings with screw holes in panel. Install large plain washer, lock washer, and screw which secures panel to each of the four mountings.

b. Thread throttle and choke control wires through guide bracket welded to front battery box. Connect throttle control to throttle lever on carburetor (control in, throttle open). Connect choke control to air shutter lever on carburetor (control in, shutter open).

ORDNANCE MAINTENANCE—GENERATING UNIT M18

- c. Insert temperature gage bulb into fitting at left rear corner of cylinder head. Tighten nut onto fitting.
- d. Connect oil pressure gage line to gage.
- e. Connect "B+" wire from starter switch to "B+" terminal of battery charging ammeter.
- f. To corresponding terminals of small terminal block, connect "61" wire from battery, "63" wire from electric brake receptacle, "IGN" wire from ignition coil, and "CG" wire from two-charge regulator.
- g. To corresponding terminals on load terminal box, connect power receptacle lead wires "A," "B," and "C."
- h. To corresponding terminals of large terminal block, connect a-c generator lead wires "F," "A1," "A2," "2C," "2B," "2A," "8," "4," and "3."
- i. Connect a-c generator lead wire "O" to "O" terminal on load terminal box.
- j. Connect a-c generator lead wires "A," "B," and "C" to corresponding terminals of circuit breaker.
- k. Install left rear side panel, hood, and all four doors.

Section II**INSTRUMENTS AND GAGES****97. OIL PRESSURE GAGE.**

a. **Description** (figs. 186 and 187). The oil pressure gage registers pressure at which oil pump is forcing oil through the engine. A copper tube connects the gage with the engine oil system. The mechanism of the instrument consists of a flattened crescent-shaped tube. As the pressure inside the tube increases, the tube straightens out. This motion is conducted to an indicator hand by linkage. Range of the gage is from zero to 50 pounds per square inch.

b. **Inspection and Repair.** Test operation by connecting gage with a tee to an accurate test gage and a source of pressure (liquid or gas). Vary pressure from zero to 50 pounds and note readings of both gages. If service gage readings vary from test gage readings, replace service gage.

INSTRUMENT PANEL**98. BATTERY CHARGING AMMETER.**

a. **Description** (figs. 186 and 187). This automotive type ammeter registers the rate of charge or discharge of the battery charging circuit. The instrument consists of a coil which sets up a magnetic field when current flows through it. This magnetism attracts or repels (depending on direction of current flow) a piece of iron. The iron is linked to a hand which indicates current flow in amperes. The ammeter reading range is from -30 amperes to $+30$ amperes.

b. **Inspection and Repair.** Connect lead wires from 6-volt dry-cell battery to posts of ammeter and note reading. Reverse leads and note reading. Repeat procedure with an accurate test ammeter. If readings of generating unit ammeter vary from test ammeter, replace the ammeter.

99. ENGINE TEMPERATURE GAGE.

a. **Description** (figs. 186 and 187). The mechanism of the temperature gage consists of a flattened crescent-shaped tube connected by linkage to the indicator hand. A flexible metal tube connects the crescent to a bulb which is held in the water jacket of the engine cylinder head by means of a fitting and nut. As engine temperature increases, fluid within the bulb is converted to gas. This gas exerts pressure on the inside of the crescent and causes it to straighten out. This motion is transmitted through the linkage to the indicator hand.

b. **Inspection and Repair.** Place bulb of gage and an accurate test thermometer in a pan of water. Heat water and compare readings of gage and an accurate thermometer at various temperatures. Replace gage if more than 2 degrees inaccurate at operating range (160°F to 190°F) or in danger range (190°F to 212°F).

100. RUNNING TIME METER.

a. **Description** (figs. 186 and 187). The running time meter is an electric clock. It registers total number of hours and tenths of hours the a-c generator has been in operation.

b. **Inspection and Repair.** Connect meter and an accurate test clock in parallel to a source of 60-cycle current. Compare elapsed time of operation registered by meter and clock. Replace meter if there is any variation from the clock.

101. FREQUENCY METER.

a. **Description** (figs. 186 and 187). The frequency meter registers cycles of alternating current generated. The mechanism consists

ORDNANCE MAINTENANCE—GENERATING UNIT M18

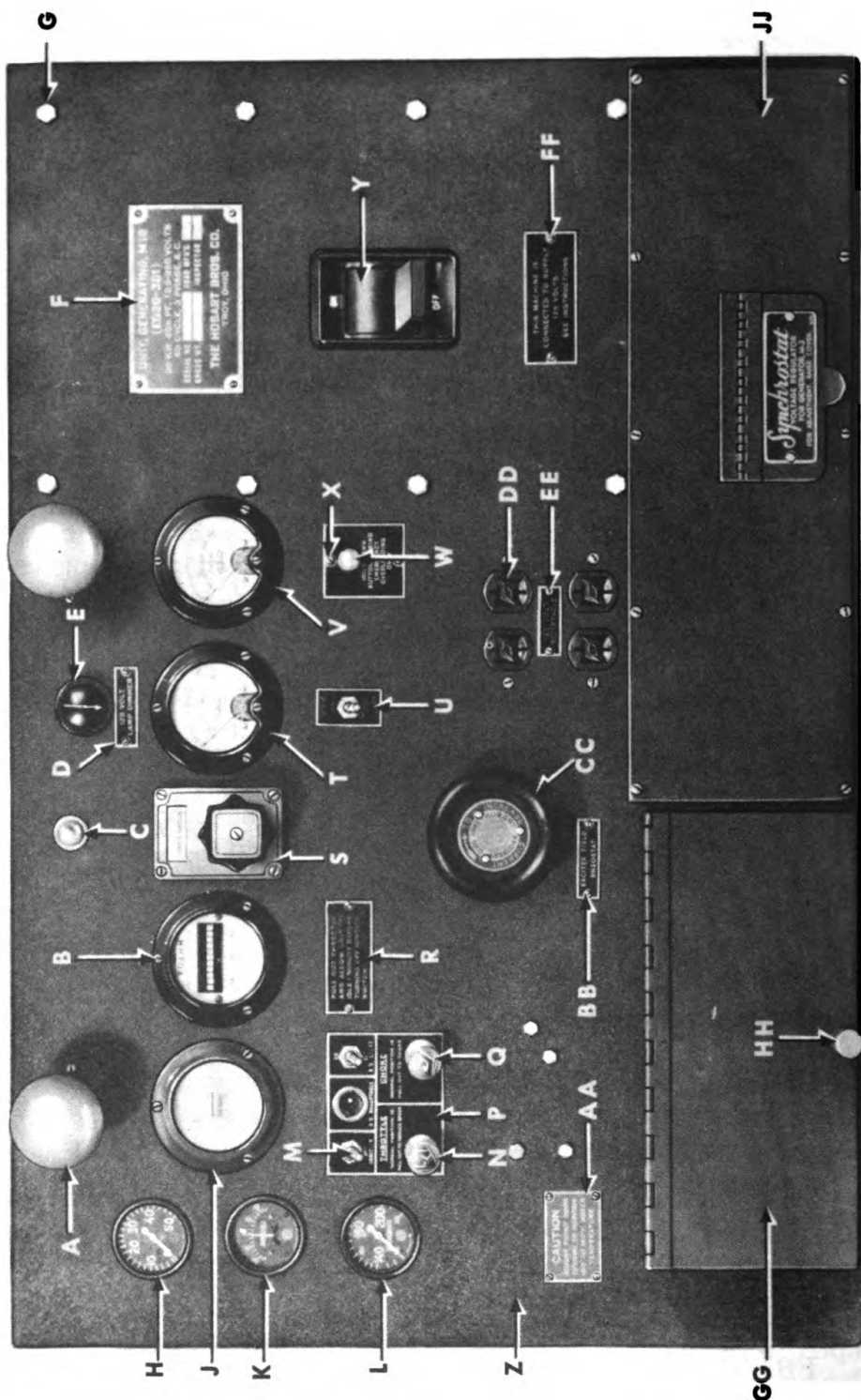


Figure 186—Instrument Panel—Front View

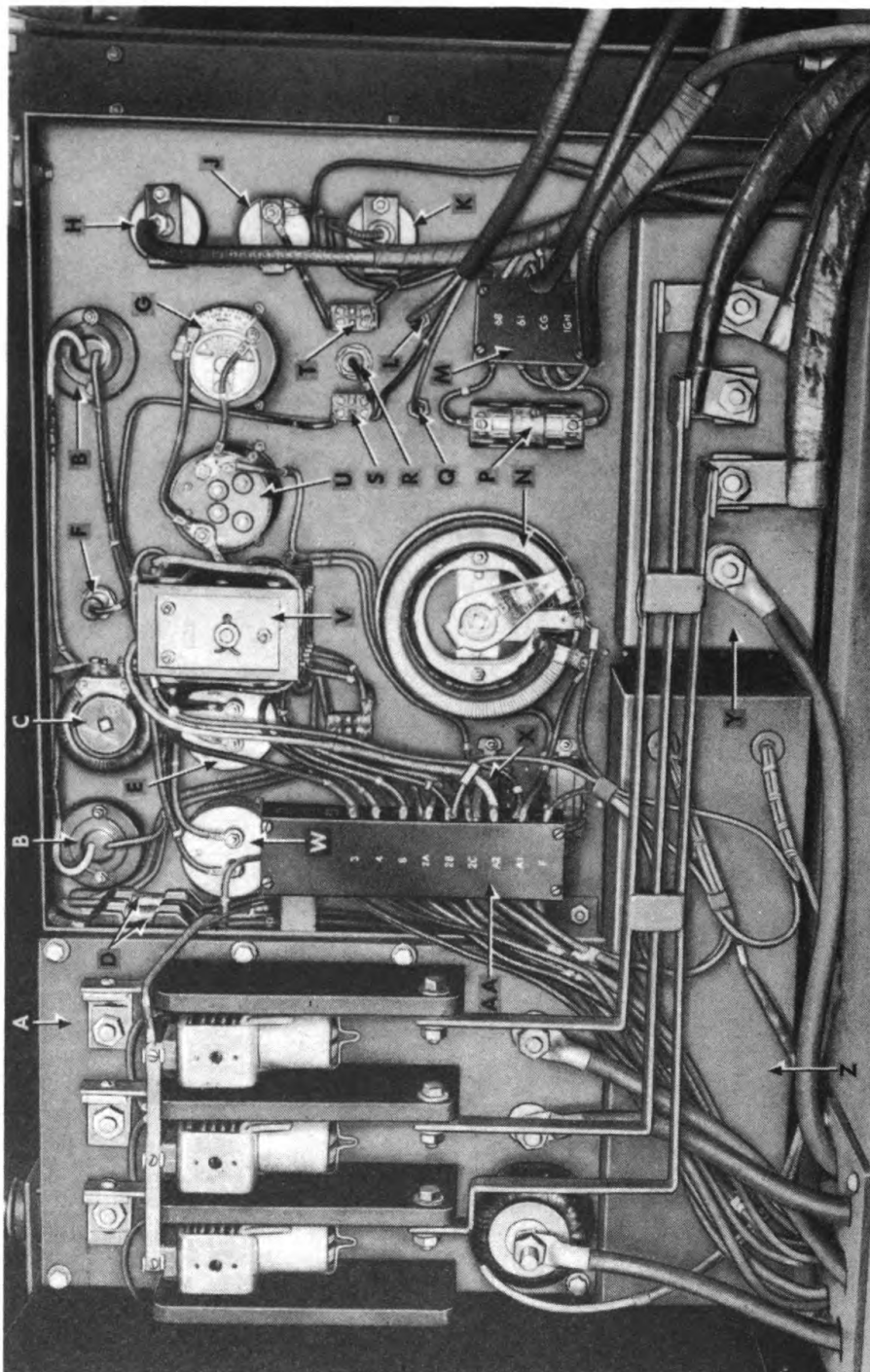
RA PD 78389

INSTRUMENT PANEL

A—LAMP—GE-50A/RS-A19	R—PLATE—A202353
B—METER—C130986	S—SWITCH, ASSEMBLY—C130968
C— <div>[LAMP—DLAX1F SOCKET—A319018]</div>	T—VOLTMETER—B181161
D—PLATE—A202346	U—PLATE—A202351
E—RHEOSTAT, ASSEMBLY—B181133	V—AMMETER—B181162
F—PLATE—B181640	W—SWITCH—A320785
G— <div>[SCREW—BCAX1BB-2 NUT—BBJXC-2 WASHER—BECX1H]</div>	X—PLATE—A320786
H—GAGE, ASSEMBLY—A202355	Y—PANEL, ASSEMBLY—D84172
J—METER—B181163	Z—PANEL—D83232
K—AMMETER, ASSEMBLY—A202354	AA—PLATE—A202357
L—GAGE, ASSEMBLY—B175949	BB—PLATE—A320619
M—SWITCH—A319015	CC—HANDLE—HBC-AW-729
N—CONTROL—B181175	DD—RECEPTACLE—B181172
P—PLATE—B181190	EE—PLATE—A202338
Q—CONTROL—B181174	FF—PLATE—B181189
	GG—LID—B181129
	HH—SCREW—A320777
	JJ—COVER, ASSEMBLY—C7669408

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Legend for Figure 186—Instrument Panel—Front View



RA PD 78569

Figure 187—Instrument Panel Installed—Rear View

INSTRUMENT PANEL

RA PD 78569A

A —CIRCUIT BREAKER PANEL	P —25-AMPERE FUSE
B —125-VOLT LAMP SOCKET	Q —CHOKE CONTROL
C —LAMP-DIMMER RHEOSTAT	R —TROUBLE LIGHT SOCKET
D —25-AMPERE FUSES	S —6-VOLT LAMP SWITCH
E —VOLTMETER	T —IGNITION SWITCH
F —6-VOLT LAMP SOCKET	U —RUNNING TIME METER
G —FREQUENCY METER	V —METER SWITCH
H —OIL PRESSURE GAGE	W —125-VOLT AMMETER
J —BATTERY CHARGING AMMETER	X —125-VOLT T-SLOT RECEPTACLE
K —ENGINE TEMPERATURE GAGE	Y —LOAD TERMINAL BOX
L —THROTTLE CONTROL	Z —VOLTAGE REGULATOR
M —SMALL TERMINAL BLOCK	AA —LARGE TERMINAL BLOCK
N —EXCITER FIELD RHEOSTAT	

Legend for Figure 187—Instrument Panel Installed—Rear View

ORDNANCE MAINTENANCE—GENERATING UNIT M18

of a number of metal reeds above an electromagnetic coil. The reeds are selected for assembly according to their periods of vibration. The reeds are then fastened in order to a base and given final adjustment by hand. The coil is connected to one phase of the generator circuit. Thus, it produces an intermittent magnetic field. Since each reed will vibrate appreciably with only one frequency, the reed having the same frequency as the current alternations will vibrate more vigorously than the other reeds. A scale beneath the reeds shows their value in cycles. At 60 cycles, the proper frequency with engine speed of 1,200 revolutions per minute, the reed above "60" mark on scale shows maximum vibration while adjacent reeds vibrate to a lesser degree. Range is from 57 to 63 cycles.

b. Inspection and Repair. Connect meter in parallel with an accurate test meter to a source of variable alternating current. Vary engine speed to obtain 57- to 63-cycle current and observe readings of both meters. Replace meter if its readings are different from readings of test meter.

102. VOLTMETER.

a. Description (figs. 186 and 187). A conventional type combination alternating-current and direct-current voltmeter is used. It measures voltage by means of an electromagnetic coil, iron armature, linkage, and indicator hand mechanism. The voltmeter is connected to the meter switch which makes it possible to read voltage of any of the three phases as well as exciter voltage. Range of the red figures is from zero to 300 volts, black figures from zero to 150 volts.

b. Inspection and Repair.

(1) Adjust hand to zero (no load) by turning adjusting screw on face of instrument below window.

(2) Connect voltmeter in parallel with an accurate test voltmeter to a source of variable alternating current. Vary current and note readings. If service voltmeter fails to give within 2 percent of the reading of test voltmeter, replace service voltmeter.

103. POWER AMMETER.

a. Description (figs. 186 and 187). An alternating-current ammeter is provided to measure amperage of the three phases. Its mechanism consists of an electromagnetic coil, iron armature, linkage, and indicator hand assembly. Increase flow of current (amperage) increases magnetism. The armature is drawn by the magnetism and moves the hand by means of the linkage. The ammeter draws its energy from the metering current transformers located behind the generator terminal box panel in stator housing (fig. 167). This is

INSTRUMENT PANEL

actually a 5-ampere ammeter, although it registers 0 to 250 amperes. The transformers cut the current down in a ratio of 250 to 5. The ammeter is connected through the metering switch which enables it to measure specific phases.

b. Tests and Adjustments (fig. 186).

(1) Adjust hand to zero (no load) by turning adjusting screw on face of ammeter below window.

(2) Connect ammeter in a circuit of a-c variable current, in series with an accurate 5-ampere test ammeter. Vary the current between 0-5 amperes and note readings on both ammeters. Replace service ammeter if its readings (black figures) fail to be just 50 times those of test ammeter at all times. NOTE: See subparagraph a, above, for cause of divergence of readings.

Section III

CONTROLS AND RECEPTACLES

104. METER SWITCH.

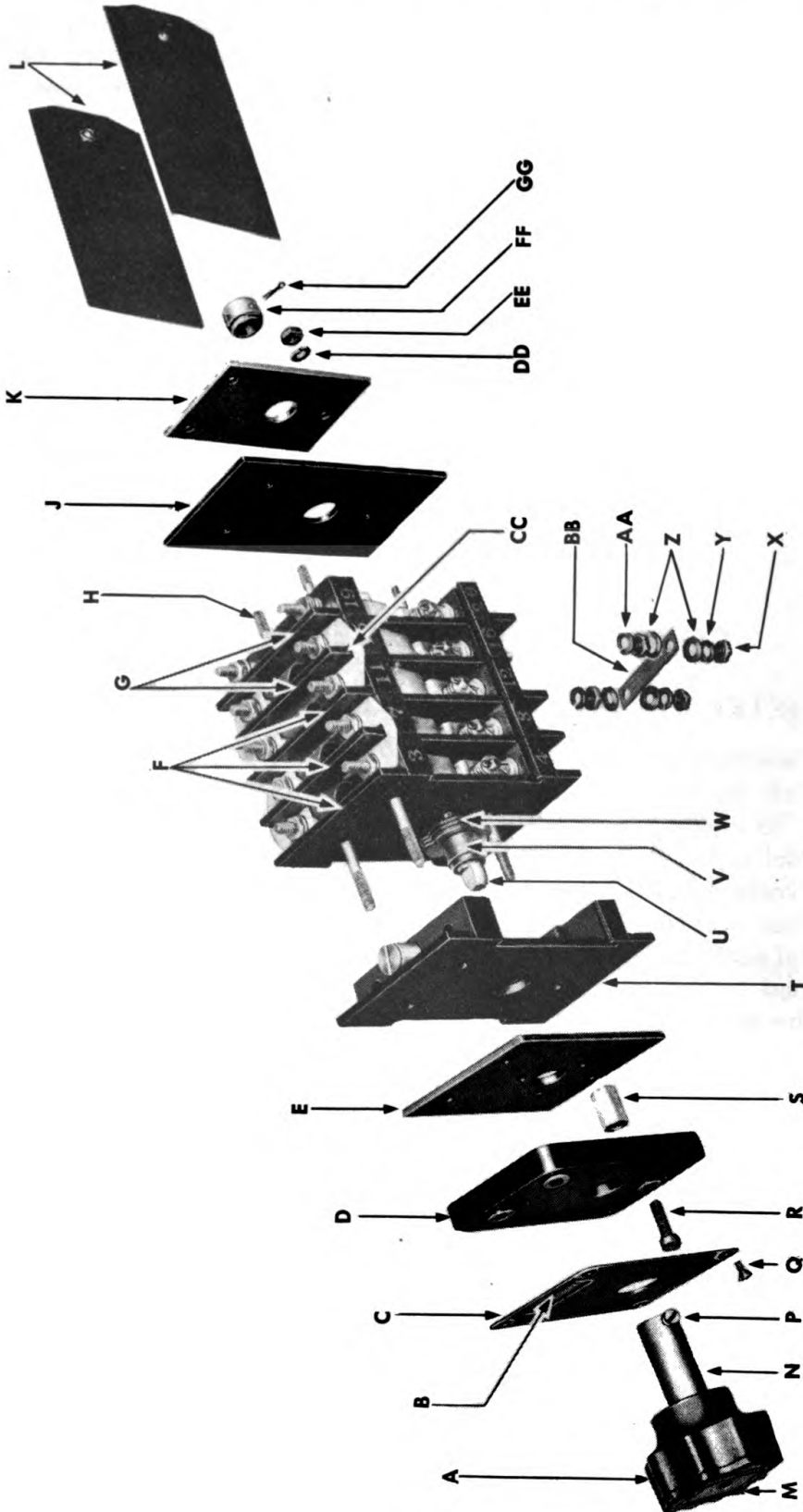
a. Description (figs. 186 and 187). A rotary type meter switch is installed on the instrument panel. Its function is to enable the operator to check the voltage of the exciter, the amperage of the current delivered to each of the three phases of the connected load, and the voltage between the phases. The method of using this switch is described in TM 9-617. The switch is housed in a bakelite case. A horizontal shaft extends the length of the switch. A knob type handle is attached to the front end of the shaft by means of a set screw. Inside the switch case, the shaft is equipped with a locator and five cams. A spring-loaded tappet presses against the locator to hold the shaft in whatever position it is set. Notches in the locator are provided for the cam to engage when the switch is set in a given position. Five contact assemblies make up the rest of the mechanism of the switch. These contacts are opened by cam action and closed by spring action.

b. Removal (figs. 186 and 187).

(1) Disconnect all wires leading to the assembly from terminals of switch.

(2) Loosen set screw which attaches handle to shaft. Pull handle from shaft.

(3) Remove the four screws which attach switch instruction plate to bakelite plate on front of instrument panel. Lift instruction plate from bakelite plate.



RA PD 46341

Figure 188—Meter Switch Disassembled

INSTRUMENT PANEL

A —HANDLE—RS-16224	R —SCREW—BCGX1.1BG-7
B — <div> <div>CARD—RS-49794</div> <div>WINDOW—RS-17904</div> </div>	S —POST—RS-17523
C —PLATE—RS-NP-1907	T —UNIT, ASSEMBLY RS-28448
D —PLATE—RS-17915	U —SHAFT—RS-28970
E —PLATE—RS-17522	V — <div> <div>BEARING—RS-17543</div> <div>PIN—RS-26409</div> </div>
F —UNIT, ASSEMBLY—RS-28952	W —LOCATOR—RS-17738
G —UNIT, ASSEMBLY—RS-28880	X —NUT—A325617
H —STUD—RS-29243	Y —WASHER—BECX1E
J —PLATE—RS-17525	Z —WASHER—RS-1221
K —PLATE—RS-17524	AA —WASHER—BECX1E
L —PANEL—RS-29251	BB —STRIP—A202339
M —PLATE—RS-NP-1654 SCREW, MACH., OVAL-HD., BR., NO. 6 (.138)-32NC-2 x 1/4	CC —JUMPER—A202350
N —EXTENSION—RS-17746	DD —WASHER—BECX1E
P —SCREW—RS-16216	EE —NUT—BBMX1C
Q —SCREW, MACH., OVAL-HD., BR., NO. 6 (.138)-32NC-2 x 1/4	FF —BEARING—RS-49988
	GG —PIN—BFAX1CG

RA PD 46341A

Legend for Figure 188—Meter Switch Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18

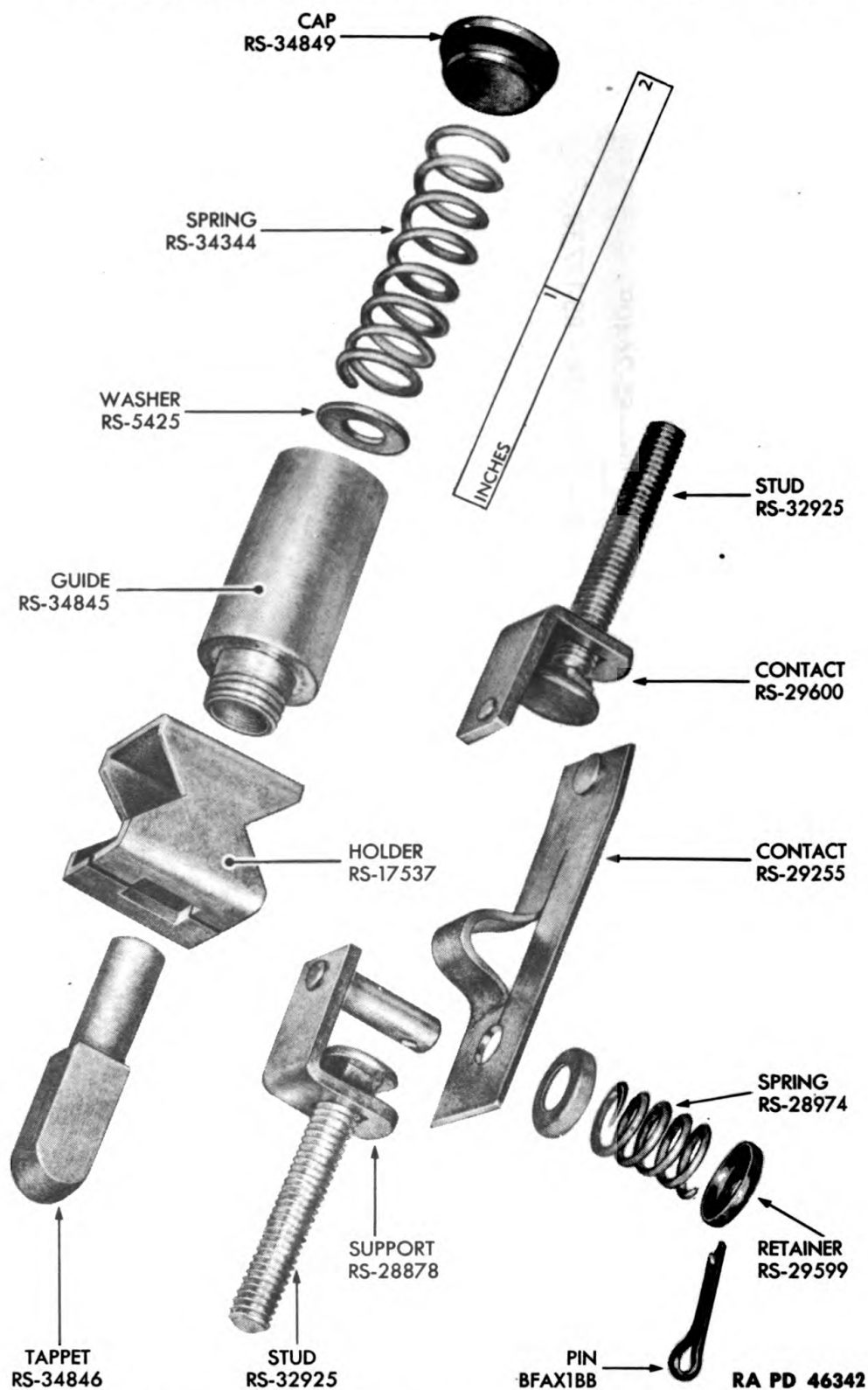


Figure 189—Meter Switch Tappet and Contacts Disassembled

INSTRUMENT PANEL

(4) Remove the three screws which extend through bakelite plate, instrument panel, and posts. Lift switch from rear of instrument panel and bakelite plate from front of it.

c. Disassembly (fig. 188).

(1) Pull the two side panels from rear of switch.

(2) Screw the three posts from studs on front of switch. Lift plate RS-17522 and assembly unit 28448 from switch.

(3) Pull cotter pin which attaches bearing to back of shaft. Slide bearing from shaft.

(4) Remove the three nuts and lock washers which attach rear plate RS-17524 and rear plate RS-17525 to switch. Lift plates from switch.

(5) From the front three pairs of terminals on underside of switch, remove the nuts, lock washers, and plain washers which attach connecting strips. Pull strips from terminals.

d. Inspection and Repair.

(1) Inspect all bakelite plate panels and units which compose the frame and case of the switch. Replace broken parts.

(2) Inspect all contacts to see if they are pitted or burned. Replace contacts which are not in good condition (fig. 189).

(3) Install tappet unit RS-28448 on switch. Install handle in position on shaft, and rotate handle to its various positions. Notice tension which tappet exerts on locker.

(4) With handle installed on shaft, rotate shaft to its various positions and check effect of cam action on movable contacts. Cams should open contacts and spring action should close contacts after cams have passed by. If cams fail to open contacts, replace entire meter switch.

e. Assembly (fig. 188).

(1) Slide plate RS-17525 and plate RS-17524 into position on studs on rear of switch. Install the three lock washers and screws which attach plates to switch.

(2) Slide bearing RS-49988 into position on rear end of shaft. Install cotter pin through bearing and shaft.

(3) Position tappet plate assembly on the three studs on front end of switch. Be sure to seat tappet on locker. Slide plate RS-17522 into position on studs over tappet unit. Screw the three posts tightly onto studs.

(4) Slide two side panels into position in tracks on sides of switch.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(5) Between terminals 2 and 4, 5 and 8, and 10 and 12, install three strips A202339. Secure each strip on each terminal with plain washer, lock washer, and nut.

f. Installation (figs. 186 and 187).

(1) Place switch in position on back of instrument panel, screw holes in posts alined with screw holes in panel. Place plate RS-17915 in position on front of panel with its screw holes alined with screw holes in instrument panel. Install the three screws which attach plate and switch to instrument panel.

(2) Place switch name plate in position on plate RS-17915. Install the four screws which attach name plate to plate RS-17915.

(3) Slide handle into position on shaft and tighten set screw.

(4) Connect wires to switch terminals as shown in the wiring diagram (fig. 141).

105. TOGGLE SWITCHES.

a. Description (figs. 186 and 187). Three identical toggle switches are used. One controls the ignition circuit, another the 6-volt instrument panel light circuit, and the other controls the 125-volt light socket. These switches are two-pole type. However, the switches used in the ignition circuit and the 6-volt instrument panel light circuit have small metal jumpers attached across adjacent terminals to make them act as single-pole switches. The 125-volt instrument panel light is used as a two-pole switch.

b. Inspection and Repair.

(1) Inspect composition body and switch to see if it is broken. Examine terminals to see if they are tight. Note condition of threads in terminals. Replace switch if defect is discovered.

(2) Turn switch off and test across poles with a test lamp. Replace switch if lamp lights.

(3) Turn switch on and test across poles with a test lamp. Replace switch if lamp fails to light.

106. EXCITER FIELD RHEOSTAT.

a. Description (figs. 186 and 187). The exciter field rheostat controls the output voltage of the unit when the generating unit is operated with the voltage regulator switch in "OFF" position. It works by introducing a resistance into the circuit. The instrument consists of a base upon which is wound a doughnut-shaped coil of resistant wire. A contact is mounted on a control shaft. Position of the shaft is controlled by means of a handle attached to the end of the shaft. The rheostat is rated at 75 ohms, with a maximum current flow of 3.5 amperes.

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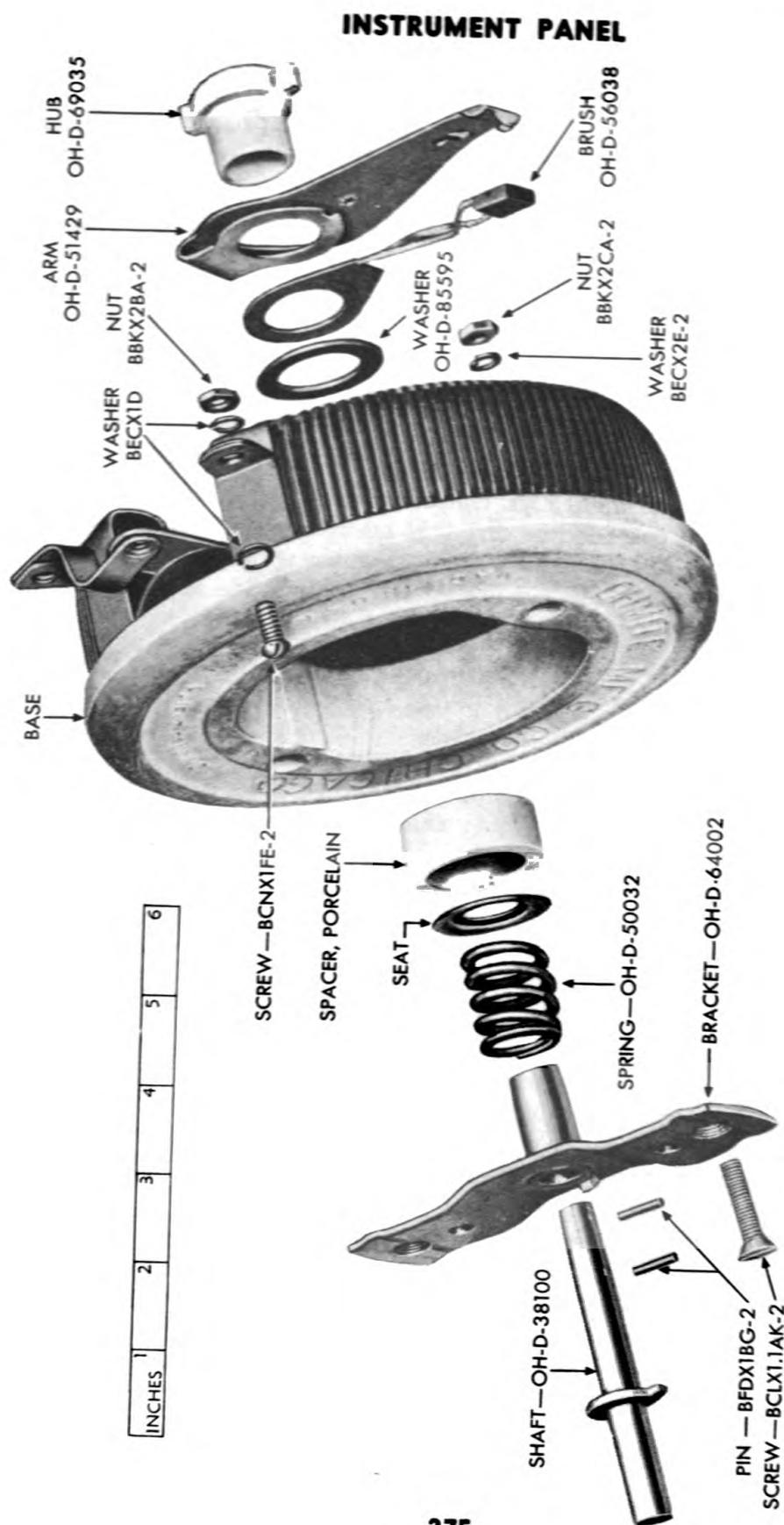


Figure 190—Exciter Field Rheostat Disassembled

ORDNANCE MAINTENANCE—GENERATING UNIT M18**b. Disassembly (fig. 190).**

(1) Press down on hub on rear end of shaft and twist one-quarter turn. Pull hub and both hub pins from shaft. Lift arm, brush, and washer from shaft.

(2) Lift shaft from front of base and remove porcelain spacer, spring seat, spring, and bracket from shaft.

(3) To remove terminals, remove nut and lock washer from terminal screws and lift screws from lugs.

c. Inspection and Repair.

(1) Check base, porcelain spacer, and hub to see if they are cracked or broken. Replace entire rheostat if base is broken.

(2) Examine terminal lugs, contact surfaces of winding and arm to see if they are corroded or dirty. If necessary clean with class B flint paper No. 2/0. Use caution when cleaning windings. They must be rubbed very lightly. Do not use an aluminum-oxide abrasive cloth. Blow dust from all parts with compressed air.

(3) Examine brush to see if it shows noticeable signs of wear or if pig tails have come loose.

d. Assembly (fig. 190).

(1) Install bracket, spring, spring seat (dished side first), and porcelain spacer on shaft. Slide shaft into position through base. On back of shaft place washer, brush, and brush arm.

(2) Insert pins through pinholes in shaft. Press hub onto shaft over pins and turn one-quarter turn.

107. OVERLOAD SWITCH.

a. Description (figs. 186 and 187). A momentary contact, single-pole, push button type overload switch is installed in a circuit breaker panel trip coil circuit. Its function is to permit the unit to deliver an overload for a short period of time without having the circuit breaker kick off.

b. Inspection and Repair.

(1) Inspect case of switch to see if it is broken. Test action of push button to see if it returns to release position. Inspect threads on terminals and terminal screws.

(2) With button released, place probes of test lamp on two terminals.

(3) With button depressed, place probes of test lamp upon the two terminals.

INSTRUMENT PANEL

- A—STUD, BR., TN-PLTD., $\frac{1}{2}$ -13NC-2 x $\frac{63}{8}$ " LONG
- B—NUT—BBCX1E-2
WASHER—BECX1M
- C—NUT, JAM, HEX, BR., $\frac{1}{2}$ -13NC-2
- WASHER, PLAIN, BR., TN-PLTD., $\frac{1}{2}$ ($\frac{9}{16}$ I.D. x $\frac{11}{4}$ O.D. x $\frac{3}{32}$ -IN. THK.)
- D—INSULATOR—A320612
- E—SEPARATOR—B181183
- F—SEPARATOR—B181181
- G—RELAY, ASSEMBLY—C130987
- H—STRIP, COP., $\frac{3}{8}$ WIDE x $\frac{1}{2}$ LONG x $\frac{1}{32}$ -IN. THK.)
- J—PLATE—C130992
- K—SCREW—BCAX1BE-2
- L—WASHER—BEBX1H-2
- M—CHANNEL—B181184
- N—BREAKER—D84173
- P—STUD—A320605
- Q—PLATE—A320604
- R—CHANNEL—C130996
- S—BLOCK—A319017
- T—FUSE, ASSEMBLY—JEC-380-025
- U—SEPARATOR—B181182
- V—BLOCK—C130990
- W—SCREW—BCAX1CE-2
- X—WASHER—BEBX1K-2
- Y—STUD—A320606
- Z—NUT—BBJX1C-2
- AA—TRANSFORMER—B181134

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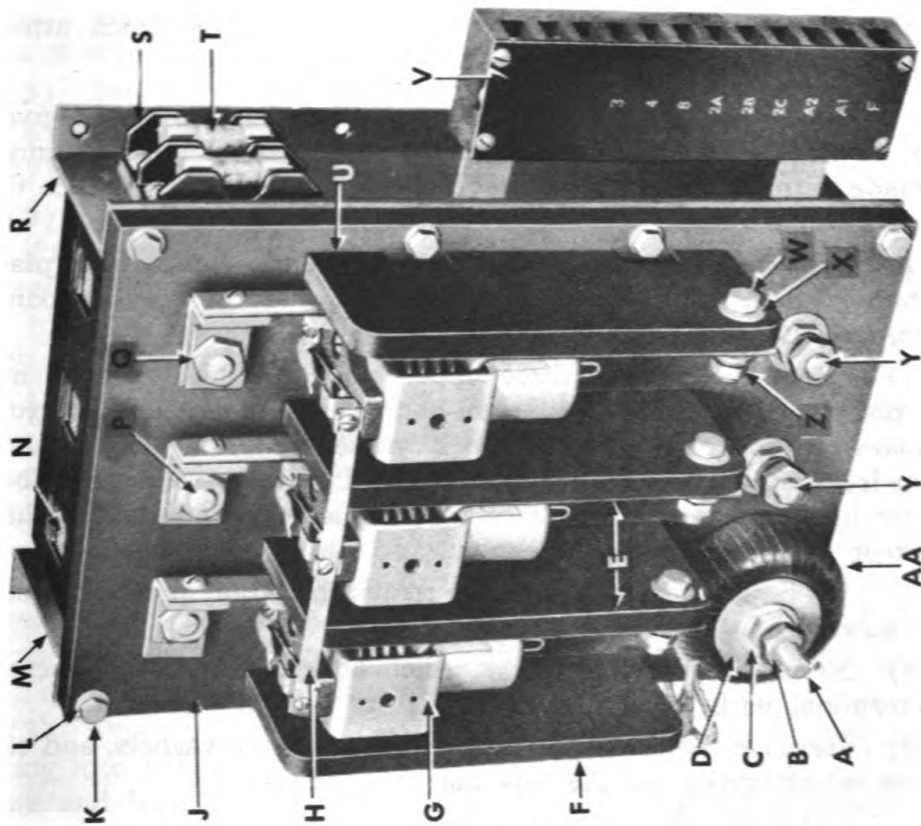


Figure 191—Circuit Breaker Panel Assembly Removed

ORDNANCE MAINTENANCE—GENERATING UNIT M18

108. CIRCUIT BREAKER PANEL ASSEMBLY.

a. **Description** (figs. 186 and 187). The circuit breaker panel assembly is attached to the rear of the instrument panel adjacent to the rear edge of the panel. The entire assembly consists of a circuit breaker proper including three overload relays, a cross-current compensating transformer, and necessary mounting plates and terminal studs. A circuit breaker serves as a load switch as well as a safety shut-off device for the output of the generator. All three phases are routed through it.

b. **Removal** (figs. 186 and 187).

(1) Remove terminal block from bracket on circuit breaker channel (par. 113 b).

(2) Disconnect main generator leads "A," "B," and "C" from corresponding terminals of circuit breaker.

(3) Disconnect bus bar from upper terminals "A," "B," and "C" on circuit breaker panel.

(4) Disconnect current compensating transformer leads "R5" and "R6."

(5) Disconnect lead "2C" from overload switch and lead "2A" from fuse block terminal, and remove fuse block from channel.

(6) Remove the eight nuts, washers, and screws which attach panel channels to instrument panel.

c. **Disassembly** (fig. 191). Only partial disassembly is given here. This is an extremely delicate assembly and if repairs cannot be made without further disassembly than is given here, replace the entire assembly.

(1) Remove the eight nuts, lock washers, screws, and plain washers which attach the two channels to sides of breaker panel assembly. Lift channels from panels.

(2) From each of the three upper studs A320605 remove nut and plate. From center and right-hand terminal studs at bottom of instrument panel, remove nut, lock washer, nut, and plain washer. From left-hand terminal stud at bottom of panel, remove nut, lock washer, nut, plain washer, insulator, transformer, nut, and plain washer. Lift rear plate from circuit breaker.

(3) To remove and disassemble relays from rear panel, proceed as follows:

(a) Remove the three screws which attach jumper strip across top terminal with relays. Lift strip from relays.

(b) Remove the three nuts, lock washers, plain washers, and cap screws which make up the bus bar terminals.

(c) Lift relays from panel.

INSTRUMENT PANEL

(d) Unhook bail from relay head and pull head from relay. Lift two spacers and coil from relay.

(e) Remove the four screws, lock washers, and flat washers which attach circuit breaker cover to front of circuit breaker. Lift cover from circuit breaker.

(f) Remove nut and plain washer from each terminal stud and remove the six studs from circuit breaker.

(g) Remove the four screws and washers which attach each of the four relay divider plates to back of rear panel. Lift plates from panel.

d. Inspection and Repair.

(1) Inspect cover, case, plates, and panel to see if any of them are cracked or broken.

(2) Test current compensating transformer for open circuit by placing probes of test lamp on insulated tips of transformer leads. Replace transformer if lamp fails to light.

(3) Set breaker handle at "ON" position and test for continuity of circuit from bottom terminal lug to top terminal lug of each of the three phases.

(4) Place circuit breaker handle in "OFF" position and repeat tests of step (3), above.

(5) Inspect contact points of all three overload relays.

(6) Inspect insulation of all exposed wires.

(7) Examine all connections to see if they are clean and tight.

(8) Examine all nuts, washers, studs, metal plates, and screws to see if they are bent, broken, burred, or if threaded parts have damaged threads. Remove burs with a fine mill file.

e. Assembly (figs. 192 and 193).

(1) Place the four relay divider panels in position on back of rear plates. Install the four washers and screws which attach each panel to plate.

(2) Install three studs A320605 in stud holes in top of circuit breaker through terminal lugs. Install flat washer and nut on each stud inside circuit breaker case. Similarly install two studs A320606 in two right-hand stud holes (facing rear of assembly) at bottom of circuit breaker case. Install long stud in same manner in left-hand hole at bottom of case. Slide a spacer onto each of the six studs.

(3) Place the two spacers in position on relay spring and slide spring into position within relay. Push head down into position on relay and hook wire bail around head. Place the three relays in position between divider strips on back of relay. Install the three

ORDNANCE MAINTENANCE—GENERATING UNIT M18

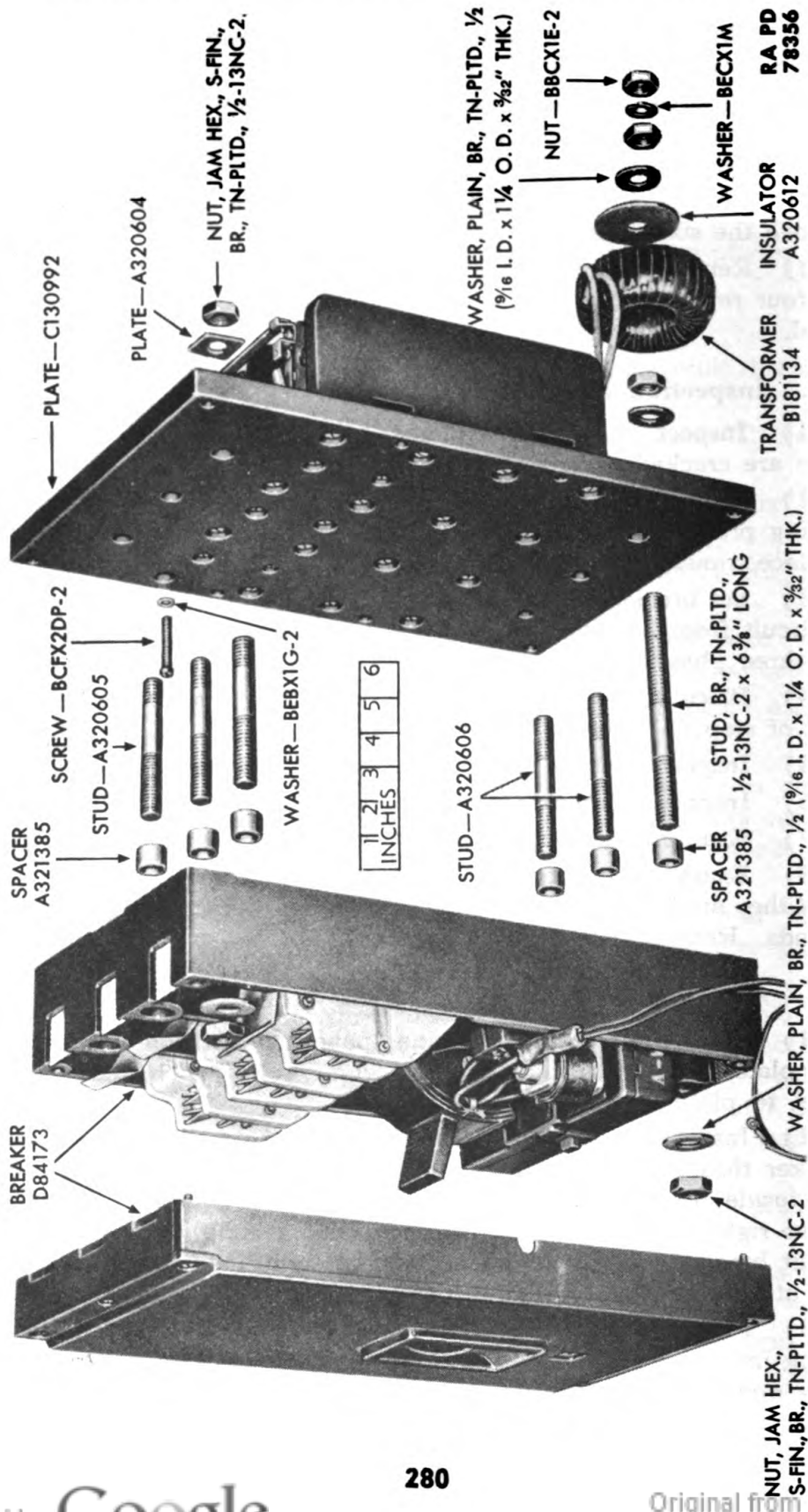
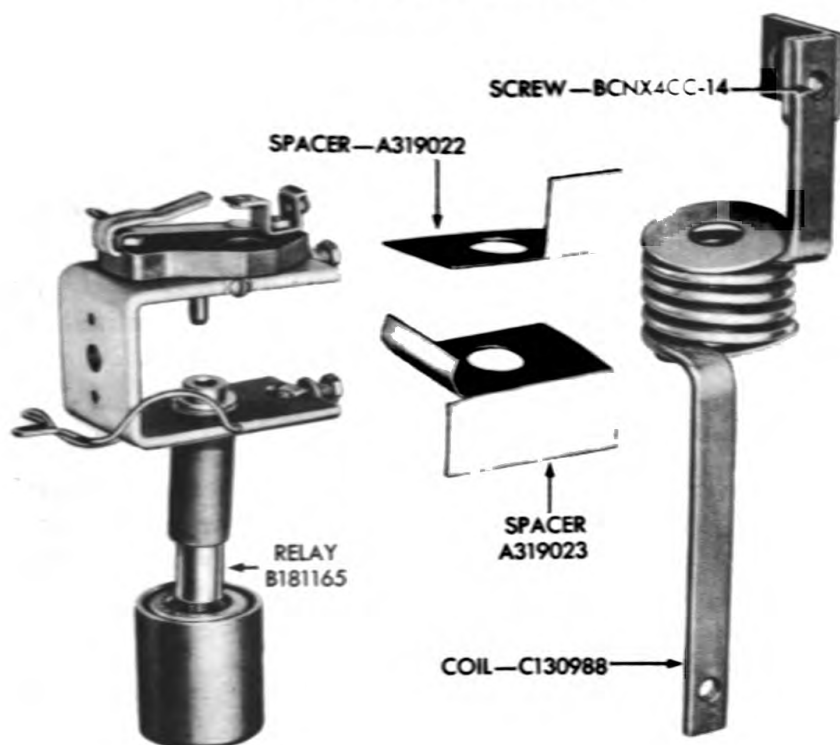


Figure 192—Circuit Breaker Panel Assembly Partially Disassembled

INSTRUMENT PANEL



RA PD 78396

Figure 193—Circuit Breaker Relay Disassembled

cap screws, plain washers, lock washers, and nuts which make up the three bus bar terminals.

(4) Place rear plate assembly in position on studs over spacers on back of circuit breaker case. On each of the three top studs install plate A320604 and nut. On each of the two right-hand lower studs install plain washer, nut, lock washer, and second nut. On long left-hand lower stud, install plain washer, nut, current compensating transformer, insulator, plain washer, nut, lock washer, and nut.

(5) Position cover on front of circuit breaker case, and install the four plain washers, lock washers, and screws which attach cover to case.

f. Installation (figs. 186 and 187).

(1) Place circuit breaker panel assembly in position on rear of instrument panel. Aline screw holes in panel channels and instrument panel, and install the eight screws, washers, and nuts which attach channels to instrument panel.

(2) Place fuse block in position on channel, and install the two screws which attach fuse block to channel.

(3) Connect lead wire "2A" to lower right-hand fuse terminal. Connect lead "2C" to the terminal on the overload switch which has no other wire connected to it.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(4) Connect current compensating transformer leads "R5" and "R6" to the correspondingly marked leads from the voltage regulator.

(5) Connect bus bar terminals "A," "B," and "C" to the corresponding upper terminals on the circuit breaker panel.

(6) Connect main generator leads "A," "B," and "C" to the corresponding lower terminals on the circuit breaker panel.

(7) Place terminal block in position on its brackets on the right-hand channel. Install the two screws which attach terminal block to channel.

109. LAMP DIMMER RHEOSTAT.

a. **Description** (figs. 186 and 187). The lamp dimmer rheostat is similar in construction and function to the exciter field rheostat previously described (par. 106), except that it is smaller in capacity and size. It is rated at 100 watts, 200 ohms, and 0.7 ampere.

b. **Disassembly** (fig. 194).

(1) Remove screw, plate, insulator, and washer from contact base at rear of rheostat.

(2) Loosen set screw and pull knob from shaft. Pry snap washer from groove in shaft. Unscrew nut from shaft. Loosen nuts on screw at rear edge of form and unhook contact pig tail from screw. Lift entire contact and shaft assembly from rear of rheostat. Slide spring and plain washer from shaft.

(3) Remove all nuts, washers, and the one jumper strip from the three terminal screws which project from side of form.

c. **Inspection and Repair.**

(1) Check porcelain form and contact base to see if they are cracked or broken. Inspect windings, contact, pig tail, strip, and terminal screws to see if they are broken, worn, or corroded. Test windings for an open circuit, indicating a break, with a 110-volt test lamp.

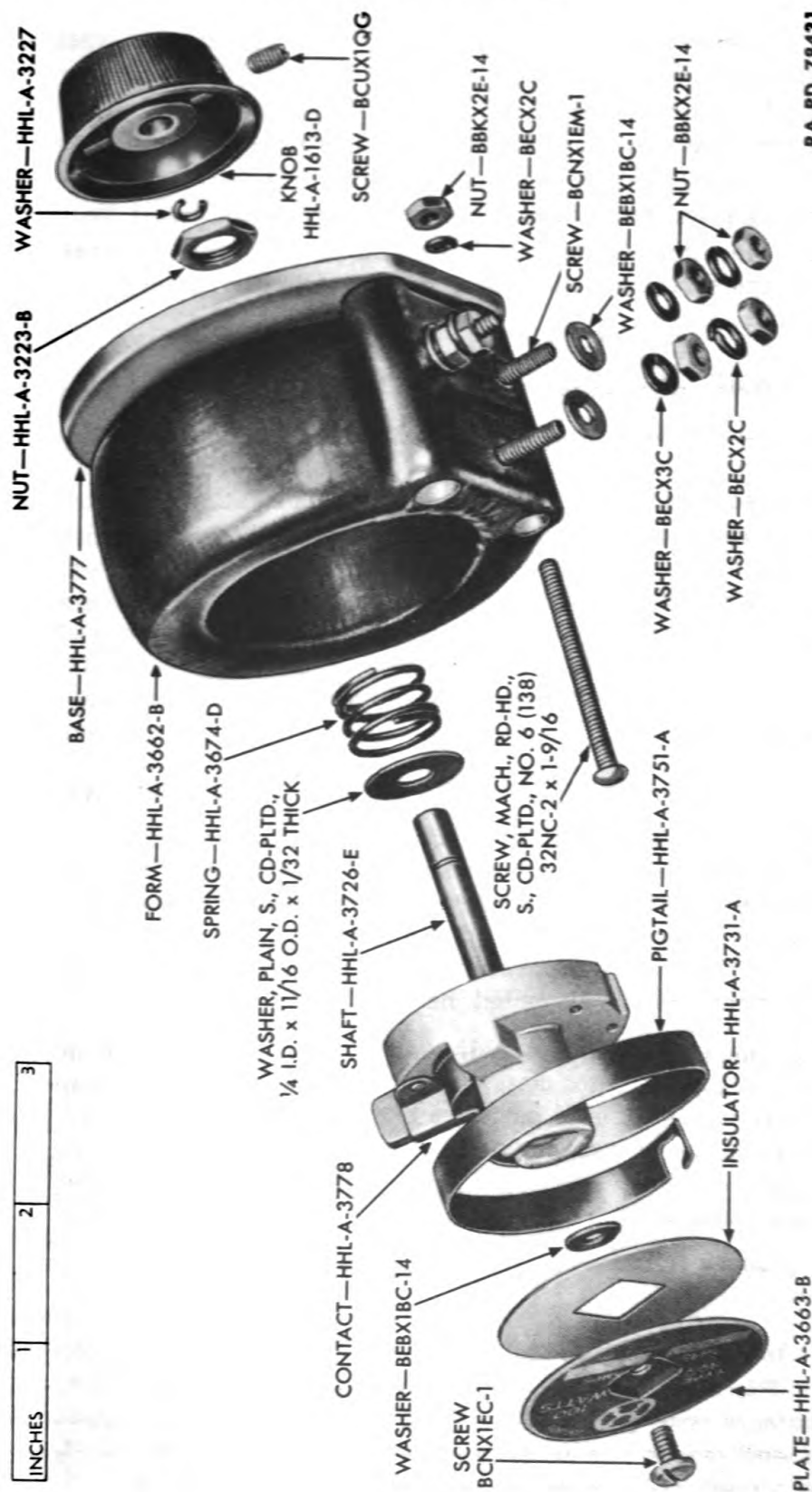
(2) Remove dirt and corrosion from contact, terminal screws, and points of contact on windings, pig tail, and jumper strip with class B flint paper, No. 2/0. Rub windings lightly if at all. Blow dust from parts with compressed air.

(3) Check tightness of the two form-to-base screws. Tighten nuts if screws are loose.

d. **Assembly** (fig. 194).

(1) Place plain washer on rear and bottom terminal screws. Slide jumper onto both screws. Install lock washer, nut, second lock washer, and second nut on each of terminal screws. Leave nuts loose on rear screw until connection of contact pig tail is made.

INSTRUMENT PANEL



RA PD 78431

Figure 194—Lamp Dimmer Rheostat Disassembled

INCHES	1	2	3
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ORDNANCE MAINTENANCE—GENERATING UNIT M18

(2) On top terminal screw, install plain washer, lock washer, nut, second lock washer and nut.

(3) Slide flat washer and spring onto front end of shaft. Insert shaft through shaft hole in base. Slide contact pig tail under head of rear terminal screw and tighten both nuts on screw.

(4) On front of shaft, install nut, snap washer, and knob.

(5) Position washer, insulator, and plate on rear of contact base. Install the screw which secures the parts to the base.

110. 125-VOLT LAMP SOCKETS.

a. **Description** (figs. 186 and 187). The two 125-volt screw type lamp sockets at the top of the instrument panel are of soft molded rubber construction. Lead wires, which project from the backs of sockets, are soldered to metal contact and shell.

b. **Inspection and Repair.** Inspect contact and shell to see if they are bent or corroded. Inspect rubber mounting to see if it is torn. Test functioning of socket by screwing a lamp into it and applying current to the leads. If corroded, clean contacts with class B flint paper, No. 2/0. If inspection reveals any other damage to lamp socket, replace the entire assembly since it cannot be disassembled.

111. 6-VOLT LAMP AND TROUBLE LIGHT SOCKETS.

a. **Description** (figs. 186 and 187). Two identical single-contact 6-volt sockets are installed on the panel. One serves as a receptacle for the 6-volt panel lamp at the top of the panel. The other is located in the engine control group and is intended to be used as a receptacle for a 6-volt trouble light. These receptacles are standard automotive type, single-contact, threaded neck, bayonet sockets.

b. **Inspection and Repair.** Clean corrosion from contact and inside of socket with class B flint paper, No. 2/0. Inspect the assembly to see if metal parts are bent or insulating parts are broken. Test operation by inserting a lamp into socket. Apply current to lead and metal part of socket. If lamp fails to light, or if other defect is discovered upon inspection, replace the entire assembly.

112. 125-VOLT T-SLOT RECEPTACLE.

a. **Description** (figs. 186 and 187). The two duplex receptacles are of molded one-piece construction. They are similar to receptacles commonly employed in the household light circuits. The case is made of bakelite, and contacts are composed of strip copper. Each receptacle is fitted with screw type terminals on its sides. Capacity rating of the receptacles is 125 volts and 15 amperes.

INSTRUMENT PANEL

b. Inspection and Repair. Inspect bakelite to see if it is broken. Clean corrosion from terminals and contact points with class B flint paper, No. 2/0. Test operation by connecting a source of current to terminals and inserting a plug connected to a lamp in T-slot. Normal lighting of lamp indicates satisfactory operation of receptacle. Replace receptacle if case is broken or if receptacle is inoperative.

113. TERMINAL BLOCKS.

a. Description (fig. 187). Two terminal blocks are mounted on the rear of the instrument panel. The smaller of the two is near the front end of the panel and is used as a junction for the engine electrical system. The larger terminal block is attached to the iron channels which mount the circuit breaker panel assembly. It serves as a junction for the alternating-current system. The smaller terminal block has four sets of terminals while the larger terminal block has 12 sets of terminals. However, only nine of the sets of terminals on the larger terminal block are used. Each of the terminal blocks consists of a bakelite base with divider strips molded between the pairs of terminals and equipped with metal inserts to receive screws. Each block is equipped with a fiber cover which attaches to the base with four screws.

b. Removal (fig. 187).

(1) Remove the four screws which attach terminal cover to terminal block. Lift cover from block.

(2) Disconnect all wires from terminals of terminal block.

(3) Remove the screws which attach designation strip along center of terminal block.

(4) Remove the two nuts, lock washers, and screws which attach terminal block to instrument panel (engine electrical system terminal block) or circuit breaker panel assembly channel (alternating-current system terminal block). Lift block from unit.

c. Inspection and Repair.

(1) Inspect terminal block cover, designation strip, and base to see if they are cracked or broken.

(2) Inspect copper strips and brass screws which make up terminals to see if they are corroded or damaged. Clean corrosion from parts with fine class B flint paper, No. 2/0. Straighten or replace bent metal parts.

(3) Inspect all screws, nuts, and lock washers to see if they are bent, broken, or have damaged threads. Remove burs with a fine mill file.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

d. Installation (fig. 187).

(1) Position terminal block on unit (engine electrical system terminal block on instrument panel; alternating-current system terminal block on circuit breaker panel assembly channel).

(2) Install the two screws, lock washers, and nuts which attach terminal block to unit. Position designated strip in groove along center of terminal block and install the screws which attach strip to terminal block base.

(3) Connect wires to terminals of terminal block as shown in wiring diagram (fig. 141).

(4) Place cover in position on back of terminal block and install the four screws which attach cover to terminal block base.

114. FUSE BLOCKS.

a. Description (figs. 187 and 191). Two fuse blocks are used. They are of similar construction although one is designed to accommodate two fuses while the other is a single fuse model. Each fuse block consists of a bakelite base to which brass fuse clips and terminal assembly are attached by screws. The double fuse block is mounted on the circuit breaker panel assembly channel above the large terminal block. The single fuse block is attached to the rear of the instrument panel adjacent to the small terminal block. Capacity rating of the fuse blocks is 250-volts and 30 amperes.

b. Removal (fig. 187).

(1) Pull fuse or fuses from block and disconnect all wires from fuse block terminals.

(2) Remove the two screws which attach fuse block to unit (double fuse block to circuit breaker panel assembly channel; single fuse block to instrument panel).

c. Inspection and Repair.

(1) Inspect base to see if it is broken. If base is broken, replace the fuse block.

(2) Inspect clips and terminals to see if they are bent, broken, or corroded. Clean corrosion from contacts and terminals with class B flint paper, No. 2/0. Straighten clips and terminals if bent. Replace fuse block if clips or terminals are broken or if threads on terminal block or screws are stripped.

d. Installation (fig. 187).

(1) Position fuse block on unit (double fuse block on circuit breaker panel assembly channel; single fuse block on instrument panel). Install the two screws which attach block.

INSTRUMENT PANEL

- (2) Connect wires as follows:
- (a) Single fuse block: to bottom terminal, wire No. 61 from terminal block; to top terminal, wire No. 63 from terminal block.
 - (b) Double fuse block: to lower left terminal, wire No. 2C from overload switch and wire No. 2C from terminal block; to upper left-hand internal, wire No. 14 from instrument panel light switch and wire No. 14 from T-slot receptacle; to lower right-hand terminal, wire No. 2A from circuit breaker and wire No. 2A from terminal block; to upper right-hand terminal, wire No. 12 from instrument panel light switch, and wire No. 12 from T-slot receptacle.
- (3) Push fuse or fuses into position in clips.
-

Section IV

VOLTAGE REGULATOR

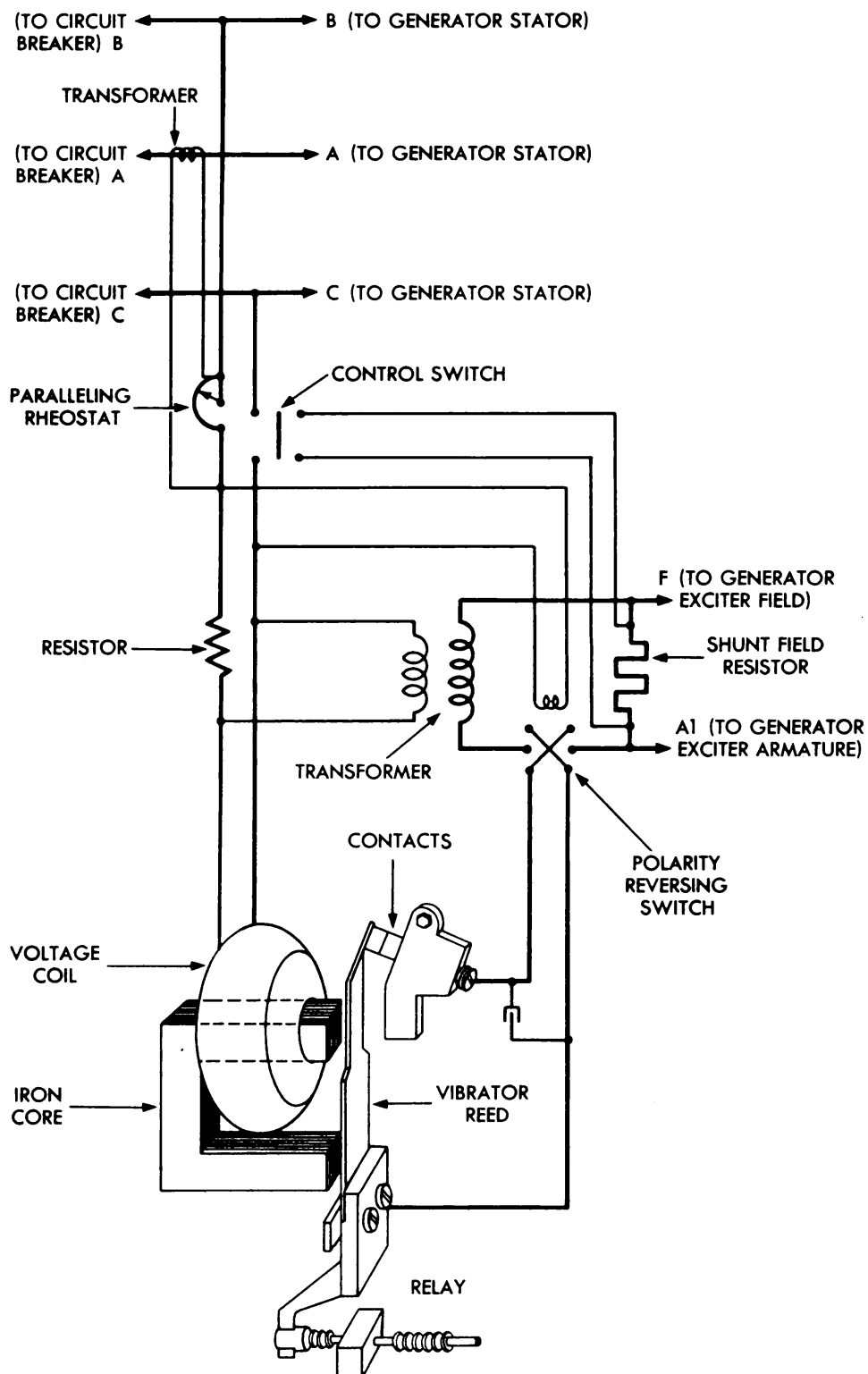
115. DESCRIPTION (fig. 195).

a. The voltage regulator is installed on the rear of the instrument panel below the circuit breaker panel assembly. Its function is to automatically control the voltage of the generator output under varying load conditions. Fine adjustment enables the voltage regulator to keep the generator's output from varying, except momentarily, more than plus or minus 2 percent of its rated voltage.

b. A voltage coil, connected across two phases of the a-c generator, is energized by the generator output. This coil magnetizes a laminated iron core which attracts a vibrator reed. One of a pair of contacts is mounted on the vibrator reed so that when the vibrator is drawn to the core, the contacts are open. When the coil is not energized, the contacts close and short circuit a shunt field resistor. Because the generator delivers alternating current, the magnetic flux is pulsating. The vibrator pulsates 120 times per second. The contacts open slightly each time the voltage wave reaches a positive or negative maximum and close each time the voltage wave goes through zero.

c. Terminal voltage of the generator determines the length of time the contacts remain open during each pulsation. When the load is removed from the generator, the generator voltage rises. This opens the contacts for a longer period. The exciter shunt field resistor, therefore, is inserted into the field circuit of the exciter for a longer period. Thus, the alternator field excitation is cut, and generator output drops to normal. Generator terminal voltage drops when a

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78578

Figure 195—Voltage Control Wiring Diagram—Simplified

INSTRUMENT PANEL

load is added to the generator. The contacts then remain closed for a longer period, or do not open at all. Since this shorts the shunt resistance in the exciter field, more excitation is delivered to the alternator field coils. This causes the output to rise quickly to normal.

d. A polarity reversing switch is provided to reverse the direction of the direct current through the contacts every 4 hours. This prevents excessive building up or pitting of the tungsten contacts. Sparking and improper wear of the contacts is further minimized by means of spark-suppressor condensers. These condensers are connected across the contact circuit.

e. Radio shielding is built into the voltage regulator in order to prevent interference with radio equipment. A grounded metal enclosure prevents radiation from the voltage regulator itself. Filter circuits prevent radiation from the leads which are brought out of the enclosure. Choke coils, having small values of inductance, oppose the flow of high-frequency currents. These coils have negligible effect upon either direct current or 60-cycle current. The condensers in the filter circuits block the flow of 60-cycle alternating current, but not the high-frequency currents. Thus, these condensers act like valves. They ground high-frequency currents, but oppose the flow of low-frequency or direct current to ground.

116. REMOVAL (figs. 187 and 141).

a. Remove tool box.

b. Disconnect the three bus bar connectors from terminals on circuit breaker panel assembly and load terminal box. Lift bus bars from unit.

c. Disconnect main generator lead wires "A," "B," and "C" from circuit breaker panel assembly. Disconnect main generator lead wire "O" from load terminal box.

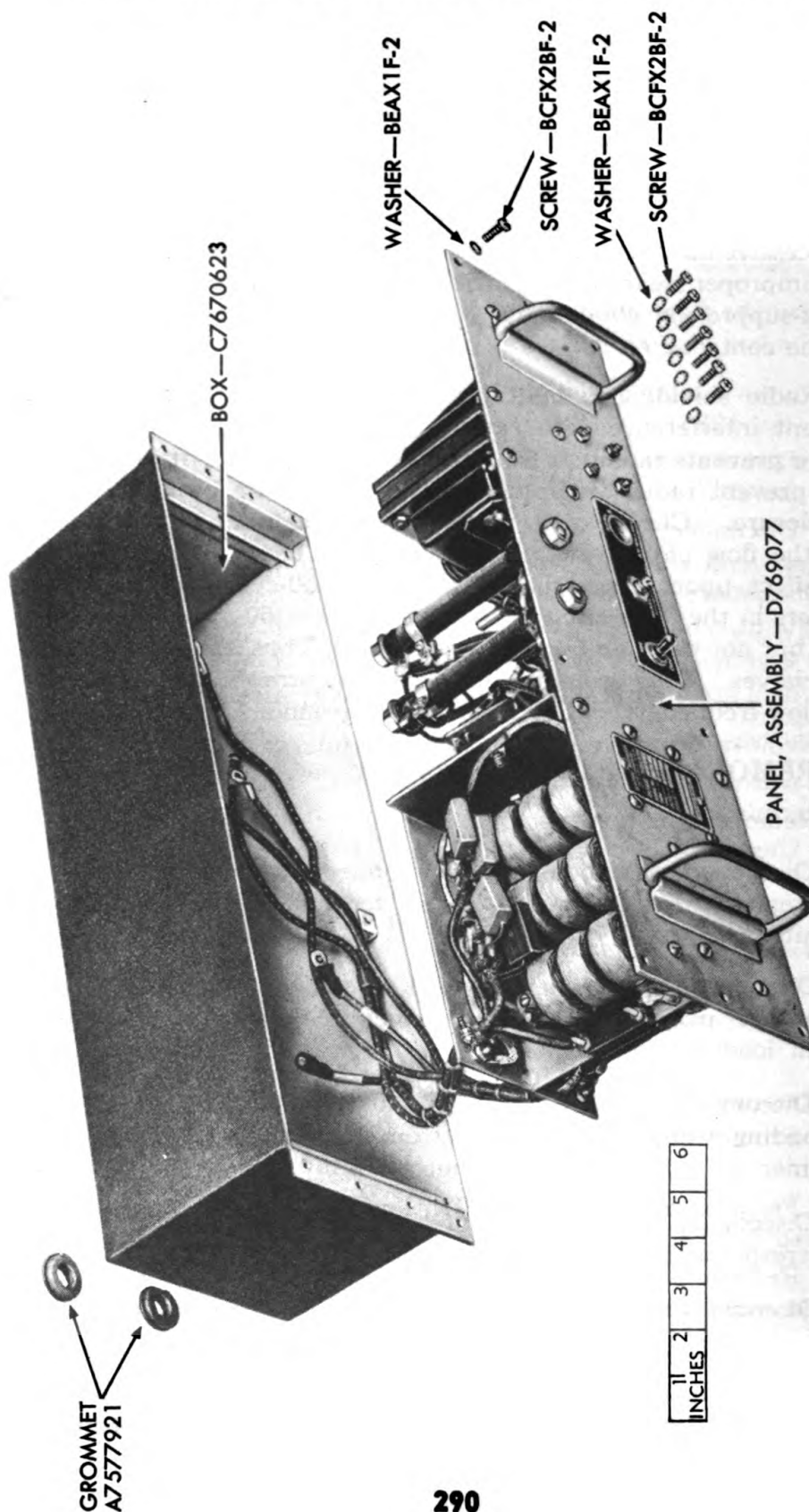
d. Disconnect voltage regulator lead wires "R5" and "R6" from correspondingly marked lead wires from cross-current compensating transformer on circuit breaker panel assembly.

e. Disconnect voltage regulator "2C," "2B," and "F" lead wires from corresponding terminals of terminal block.

f. Disconnect voltage regulator lead wire "R4" from "R4" terminal of exciter field rheostat.

g. Remove the eight flathead screws which secure voltage regulator to instrument panel. Lift voltage regulator from rear of instrument panel.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78387

Figure 196—Voltage Regulator—Box Removed

INSTRUMENT PANEL**117. DISASSEMBLY.**

a. Only partial disassembly is given here. If it proves impossible to make needed repairs with the instructions given here, replace the entire voltage regulator.

b. Remove the eight screws and internal toothed lock washers which attach the panel assembly to the box. Lift box from rear of voltage regulator (fig. 196).

c. Pry the two rubber grommets from the wire exit holes in the rear of the box (fig. 215).

d. Remove relay assembly (under transformer) from panel as follows (fig. 198):

(1) Remove the nut, washer, and screw which attach ground wire to panel.

(2) Disconnect lead wires "7B" and "8C" from terminals on coil. Disconnect lead wire "B" from terminal on contact adjusting screw post. Disconnect lead wire "A" from screw which attaches it to insulated plate at center of bracket.

(3) Remove the four nuts, internal toothed lock washers, and screws which attach bracket to panel. Lift relay assembly from panel.

e. Remove transformer from panel as follows (fig. 198):

(1) Unsolder and remove lead wires "3C" and "3B" from transformer terminal "3."

(2) Unsolder and remove lead wire "0" from transformer terminal "4."

(3) Unsolder and remove lead wires "1" and "2" from transformer terminals "1" and "2" respectively.

(4) Remove the four nuts, internal toothed lock washers, and screws which attach transformer to panel. Lift transformer from panel.

f. Remove resistor A7576987 as follows (fig. 198):

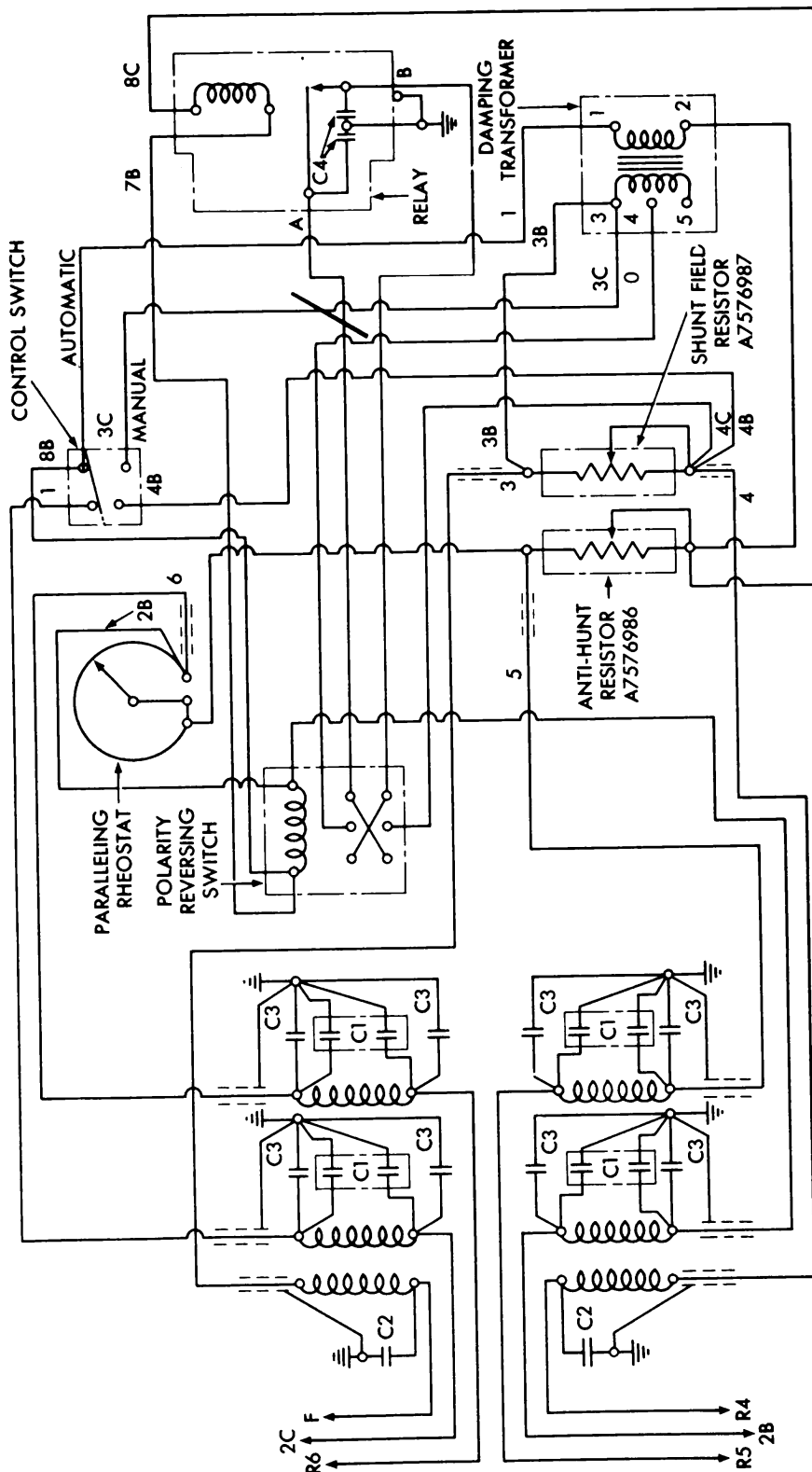
(1) From terminal adjacent to panel, unsolder lead wires "3" and "3B."

(2) From terminal farthest from panel, unsolder and remove lead wires "4," "4B," and "4C."

(3) Remove nut, internal toothed lock washer, and brass washer from stud which attaches resistor to panel. Slide resistor from stud.

g. Remove resistor A7576986 as follows (fig. 198):

(1) From resistor terminal adjacent to panel, unsolder and remove lead wire "5" and unmarked wire from paralleling rheostat.



RA PD 86523

Figure 197—Voltage Regulator Wiring Diagram

INSTRUMENT PANEL

(2) From terminal farthest from panel, unsolder and remove two unmarked lead wires which come from relay and transformer.

(3) Remove nut, internal toothed washer, and brass washer from stud which attaches resistor to panel. Lift resistor from stud.

h. Remove paralleling rheostat A7577920 as follows (fig. 198):

(1) From contact terminal (center terminal), unsolder and remove unmarked lead wire which comes from resistor A7576986.

(2) From right-hand terminal (facing rear of rheostat), unsolder and remove lead wires "6" and "2B."

(3) On front of panel, remove nut which attaches rheostat to panel. With a long thin screwdriver, break solder to detach ground strip from panel between rheostat and rear of panel. Slide rheostat from panel.

i. Remove control switch A7576992 as follows (fig. 196):

(1) From lower left-hand terminal, unsolder and remove lead wire "3C."

(2) From lower right-hand terminal, unsolder and remove lead wire "4B."

(3) From upper left-hand terminal, unsolder and remove lead wire "8B" and unmarked lead wire which goes to the transformer.

(4) From upper right-hand terminal, unsolder and remove lead wire "1."

(5) From front of panel, remove gnurled switch retaining nut. Lift switch and internal toothed lock washer from rear of panel.

j. Remove polarity reversing switch B7635943 together with radio noise suppression units, as follows (fig. 198):

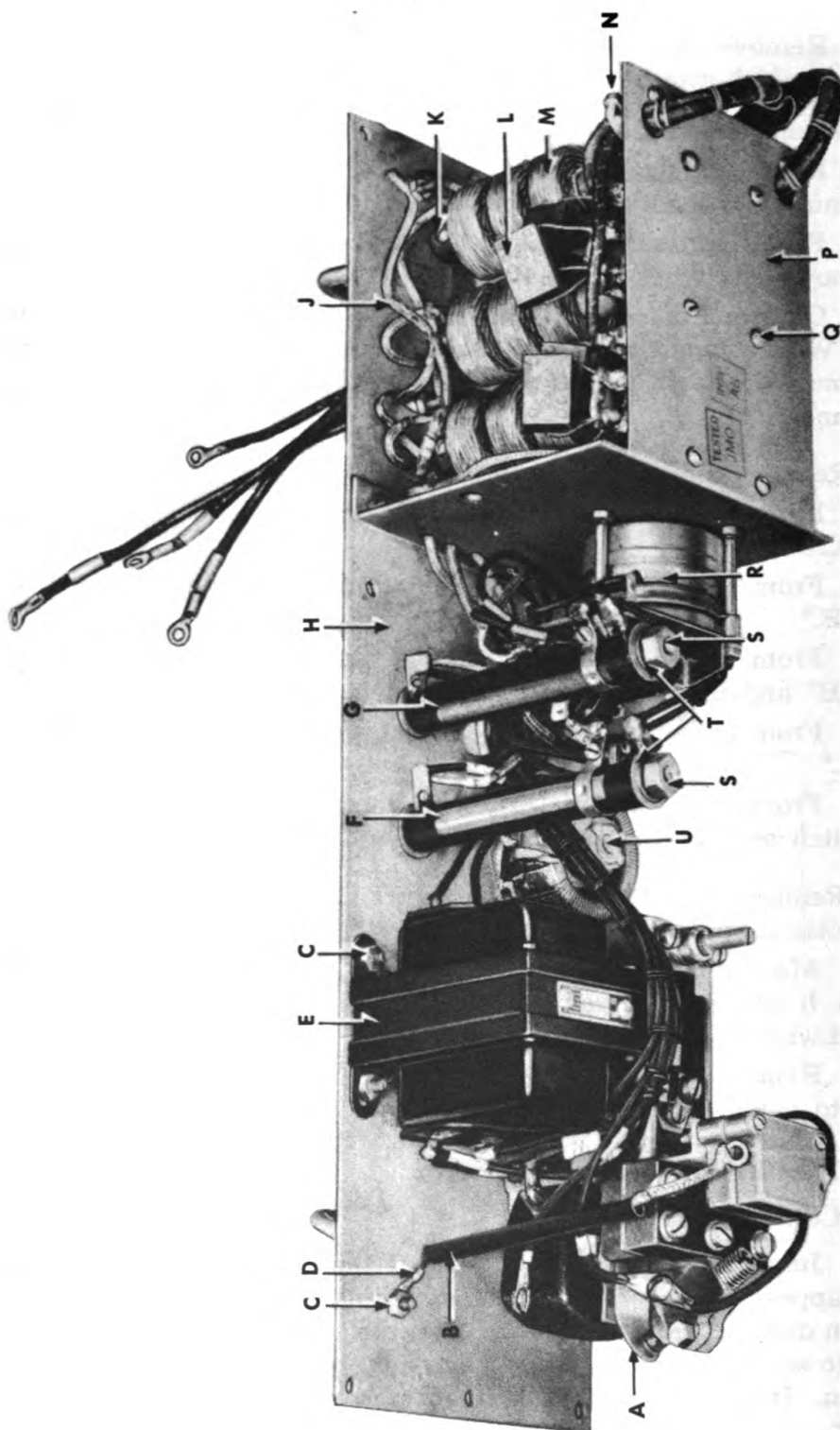
(1) After removing other units from panel, subparagraphs a through h above, remove the four nuts and screws which attach shielded wire grounding lugs to panel.

(2) Remove six nuts, screws, and lock washers which attach switch to panel. Lift switch assembly from panel.

118. INSPECTION AND REPAIR.

a. Contact Points.

(1) Inspect contact points to see if they are pitted or if sharp points appear on the face. Contact points consist of a 0.040-inch tungsten disk welded to a piece of steel the same diameter. Examine points to see if they are worn so that steel backing is visible through tungsten. If points are pitted or built up irregularly, dress them down on a fine oilstone. Replace contacts if steel backing shows through tungsten points, or if tungsten is worn to less than 0.005-inch thickness.



RA PD 78411

Figure 198—Voltage Regulator—Rear View With Box Removed

INSTRUMENT PANEL

RA PD 78411A

- A—RELAY, ASSEMBLY—D7690101
 B—TUBING, PLASTIC,
 NO. 3 x 3" LONG
 [SCREW—BCNX1FG-2
 NUT—BBKX2BA-2
 WASHER—BEAXIE
] D—TERMINAL—A7575200
 E—TRANSFORMER—B7635941
 F—RESISTOR—A7576987
 G—RESISTOR—A7576986
 H—PANEL—B7636760
 J—BRAID, COP., TN-PLTD., 1/8" x 5FT. LONG
 [SCREW, MACH., RD-HD., S., ZN-PLTD., NO. 6
 (.138)—32NC-2 x 2 5/8
 NUT—BBKX2AA-2
 WASHER—BEAXID
] K—
 L—CAPACITOR—A7577009
 M—COIL—B7636622
 N—CLAMP—A7576985
 P—BRACKET—B7636619
 [SCREW—BCNXIEE-2
 NUT—BBKX2AA-2
 WASHER—BEAXID
] Q—
 R—SWITCH—B7635943
 [STUD—A7576988
 NUT—BBAX1A-2
 WASHER—BEAXIH
 WASHER—BEBX1BG
] S—
 T—WASHER—A7576989
 U—RHEOSTAT—A7577920

Legend for Figure 198—Voltage Regulator—Rear View With Box Removed

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(2) Replace contact points as follows:

(a) Unscrew stationary contact from adjusting screw and install new stationary contact.

(b) Loosen the two screws which clamp reed in position. Pull reed from relay. Slide new reed into position.

(c) Line up contacts and tighten the two clamp screws securely.

(d) Adjust reed to case air gap (step (3), below).

(3) Check and adjust air gap between reed and laminated iron core. Measure gap with 0.032-inch feeler gage. If necessary, adjust by screwing voltage regulator screw A7577003 to right or left until proper clearance is obtained. Then, check contact points to see if they are closed. If not closed, loosen clamp screw and turn stationary contact adjusting screw until contact is made. Tighten clamp screw.

b. **Resistors.** The capacities of the resistors are 200 and 500 ohms respectively. Capacity is marked on each resistor. Test each resistor with an ohmmeter. If ohmmeter shows reading under resistor capacity, a shorted resistor is indicated. Resistance in excess of resistor capacity indicates an open or partially opened circuit in resistor. Replace resistors which have shorted circuit or open circuit.

c. **Paralleling Rheostat.**

(1) Test paralleling rheostat for an open circuit with a test lamp. Place probes on center and right-hand (facing rear of rheostat) terminals. Turn contact from "OFF" position to full "ON" position. Test lamp should gradually grow brighter during process to full brightness with rheostat fully on.

(2) Inspect rheostat terminals, windings, and contacts to see if they are corroded. Remove corrosion with fine flint paper. Do not remove more wire from windings than absolutely necessary. Blow all dust from rheostat with compressed air.

d. **Control Switch.** Test across both poles of control switch with a test lamp. If lamp lights across either pole with switch off, or if lamp fails to light across either pole with switch on, replace switch.

e. **Transformer.**

(1) With a test lamp, test for continuity of circuit between terminals one and two, three and four, and four and five. Replace transformer if lamp fails to light on any test, as this would indicate an open circuit.

(2) Ground one probe of test lamp to unpainted spot on laminated core of transformer. Touch other probe to each terminal, one at a time. If lamp lights on any test, a grounded circuit is indicated. Replace transformer if grounded.

INSTRUMENT PANEL

f. Polarity Reversing Switch.

(1) Inspect all connections on switch to see if any have come unsoldered or disconnected.

(2) Connect 60-cycle, 6-volt, current leads to motor leads. Watch switch-operating cam. A slight movement, at the rate of one revolution every 8 hours, indicates motor is functioning properly.

(3) With switch-operating cam in one of its two positions, test for continuity of its circuit from center terminal to both sets of end terminals with a test lamp. Lamp should light across one pair of poles only. Run motor until switch-operating cam is in other position and repeat test lamp test. Lamp should light across other pair of poles and not across pair on which lamp originally lighted. Replace switch if motor is inoperative or if switch does not function properly, as determined by test lamp checks.

(4) Test the 18 radio noise suppression choke coils for continuity of circuit with a test lamp. Place one probe on each lead. If lamp lights, no open circuit is indicated. Test choke coil for grounded circuit with a test lamp. Place one probe on coil lead, place the other probe on framework. If lamp lights, coil is grounded. Replace assembly if choke coils are grounded or have open circuits. Test coils for open circuit by running 6-volt direct current through each bank of three coils which are connected in series. Measure voltage drop by inserting needle pointed probes of voltmeter into leads from each coil, one coil at a time. Observe reading of voltmeter on each test. If voltage drop is appreciably less on any one coil, a shorted circuit is indicated within that coil. Replace assembly if choke coils are short circuited.

(5) Disconnect one connection of each radio noise suppression condenser. To test radio suppression condenser, connect in series a probe, a source of 90-volt direct current, a neon light, and another probe. Touch the two probes to the two leads from each condenser. Repeat test from ground terminal of condenser to each positive terminal of condenser if condenser has more than one positive connection. If lamps light continuously, a shorted circuit within condenser is indicated. If lamp fails to light at all, an open circuit within condenser or leads is indicated. If lamp blinks on and then goes out, a properly functioning condenser is indicated. Unsolder connections of improperly functioning condensers, and replace condenser with another of the same capacity. Capacity of condenser is stamped on each condenser. After making tests, solder negative lead to ground on each condenser.

119. ASSEMBLY.

a. Install Polarity Reversing Switch, Together With Radio Noise Suppression Units B7635943 (fig. 198).

(1) Position switch assembly on rear of panel. Install the six

ORDNANCE MAINTENANCE—GENERATING UNIT M18

screws, lock washers, and nuts which attach switch to panel.

(2) Attach each of the four shielded wire ground lugs to panel with screw and nut provided for the purpose.

(3) Install control switch, paralleling rheostat, resistor, transformer, and relay on panel (subpars. b through g, below).

b. Install Control Switch (fig. 196).

(1) Position switch in vertical position on rear panel with shaft through panel. Be sure internal toothed lock washer is properly positioned on switch shaft sleeve. Install narrowed switch retaining nut on front of panel.

(2) Solder lead wire "1" to upper right-hand terminal.

(3) On upper left-hand terminal, solder lead "8B" and unmarked lead wire from transformer.

(4) Solder lead wire "4B" to lower right-hand terminal.

(5) Solder lead wire "3C" to lower left-hand terminal.

c. Install Paralleling Rheostat (fig. 198).

(1) Position rheostat on rear of panel with shaft projecting through its hole in panel. Install nut on shaft sleeve in front of panel.

(2) Solder ground strip to panel between rheostat and panel.

(3) Facing rear of rheostat, solder lead wires "6" and "2B" to right-hand terminal.

(4) Solder unmarked lead wire from resistor A7576986 to center terminal. Check for presence of jumper wire from center to left-hand terminals.

d. Install Resistor A7576986 (fig. 198).

(1) Slide resistor into position on right-hand (facing rear of panel) resistor stud. Install brass washer, internal toothed lock washer, and nut on the stud.

(2) Solder the two unmarked lead wires which come from relay and transformer to terminal most remote from panel.

(3) Solder lead wire "5" and unmarked wire from paralleling rheostat to resistor terminal adjacent to panel. Check for presence of jumper wire from terminal farthest from panel to clamp terminal toward center of resistor.

e. Install Resistor A7576987 (fig. 198).

(1) Facing rear of panel, slide resistor onto left-hand resistor stud. Install brass washer, lock washer, and nut on stud.

(2) Solder lead wires "4," "4B," and "4C" to resistor terminal farthest from panel. Check for presence of wire jumper from this terminal to clamp terminal toward center of resistor.

INSTRUMENT PANEL

(3) Solder lead wires "3" and "3B" to resistor terminal adjacent to panel.

f. Install Transformer (fig. 198).

(1) Position transformer on rear of panel with screw holes in transformer alined. Install the four screws, internal toothed lock washer, and four nuts which attach transformer to panel.

(2) Solder lead wire "2" to transformer terminal "2."

(3) Solder lead wire "1" to transformer terminal "1."

(4) Solder lead wire "0" to transformer terminal "4."

(5) Solder lead wires "3B" and "3C" to transformer terminal "3."

g. Install Relay Assembly (fig. 198).

(1) Position relay assembly on panel underneath transformer with screw holes in relay base and screw holes in panel alined. Install the four screws, internal toothed lock washers, and nuts which attach relay to panel.

(2) Connect lead wire "A" with screw which attaches it to insulated plate at top center of relay bracket.

(3) Connect lead wire "B" to terminal on contact adjusting screw post.

(4) Connect lead wire "7B" to coil terminal adjacent to transformer.

(5) Connect lead wire "8C" to coil terminal more remote from transformer.

(6) Slide plastic tubing onto relay ground wire and attach ground wire to panel with screw, lock washer, and nut.

h. Install Box (fig. 196).

(1) Snap the two rubber grommets into position in the two wire exit holes on the rear of the box.

(2) Set voltage regulator assembly in position in its box and install the eight internal toothed lock washers and screws which attach panel to box.

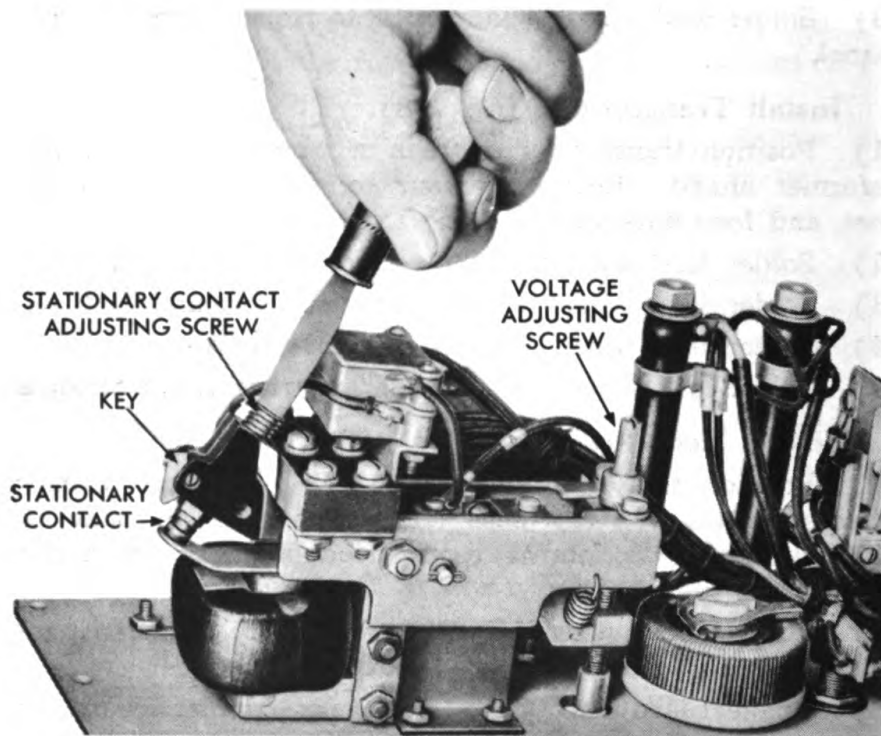
120. INSTALLATION (figs. 187 and 197).

a. Place voltage regulator in position on rear of instrument panel under circuit breaker panel assembly. Install the eight flathead screws which secure voltage regulator to instrument panel.

b. Connect voltage regulator lead wire "R4" to "R4" terminal of exciter field rheostat.

c. Connect voltage regulator wires "2B," "2C," and "F" to corresponding terminals of terminal block.

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78590

Figure 199—Voltage Regulator Contact Point Adjustment

d. Connect voltage regulator lead wires "R5" and "R6" to correspondingly marked lead wires from cross-current compensating transformer on circuit breaker panel assembly.

e. Connect main generator lead wires "A," "B," and "C" to "A," "B," and "C" terminals, respectively, of breaker panel assembly. Connect main generator lead wire "O" to "O" terminal on rear of load terminal box.

f. Position the three bus bars on "A," "B," and "C" bus bar terminals on circuit breaker panel assembly and on "A," "B," and "C" terminals on rear of load terminal box. Install the flat washers, lock washers, and nuts which attach bus bar to terminals. Be sure to connect power receptacle leads "A," "B," and "C" to "A," "B," and "C" terminals, respectively, on rear of load terminal box when connecting bus bar.

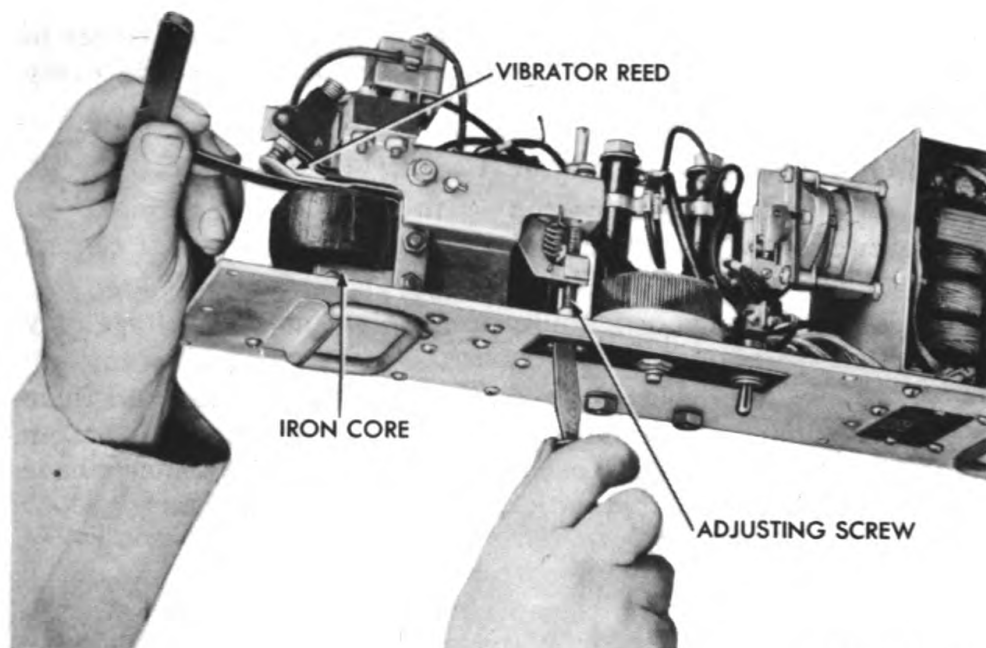
g. Install tool box.

121. ADJUSTMENTS (figs. 199 and 200).

a. Voltage Regulator Adjustment.

(1) Turn field rheostat to position of maximum excitation, therefore maximum voltage. Be sure main switch is off.

INSTRUMENT PANEL



RA PD 78579

Figure 200—Voltage Regulator Air Gap Adjustment

(2) Lift voltage regulator cover (marked "Synchrostat") on front of instrument panel.

(3) Put the "ON-OFF" switch to the "ON" position.

(4) The paralleling rheostat should be adjusted to the normal setting. This setting is approximately one-half way between the "IN" and "OUT" positions. Count the number of turns between the two positions and set the rheostat at the midturn.

(5) Set the desired voltage by adjusting a-c voltage adjusting shaft. Then with main switch on and generator operating under load, make final adjustment of a-c voltage adjusting shaft for desired voltage.

b. Adjustment of Air Gap Between Vibrator and Laminated Iron Core (fig. 200).

(1) Remove front cover plate of voltage regulator.

(2) Remove eight screws and internal toothed lock washers which hold voltage regulator box to panel. Pull out voltage regulator box, using the handles on the box. Movement of box is limited because of wires running into right side of box.

(3) The vibrator air gap is adjusted by turning the stationary contact adjusting screw clockwise or counterclockwise. (Clamping screw must be loosened before and tightened after working on stationary contact adjusting screw.)

ORDNANCE MAINTENANCE—GENERATING UNIT M18

(4) The air gap between the core and vibrator should be set to approximately 0.032 ($\frac{1}{32}$) inch. Air gap should be checked every 3 months.

c. Maintenance of Regulator Contact Points.

(1) The contact points are subject to some wear in normal operation. Adjustment of voltage adjusting shaft to compensate for contact wear must be made occasionally.

(2) Erratic voltage or inability to maintain normal voltage may indicate that the regulator contacts need attention.

(3) If inspection shows that contacts are quite pitted and there are sharp points on the surface, remove the contacts and dress them down with a fine emery cloth or fine oilstone. After the contacts have been dressed and reinserted, adjust the air gap if necessary.

CHAPTER 7

RADIO INTERFERENCE SUPPRESSION

122. DESCRIPTION.

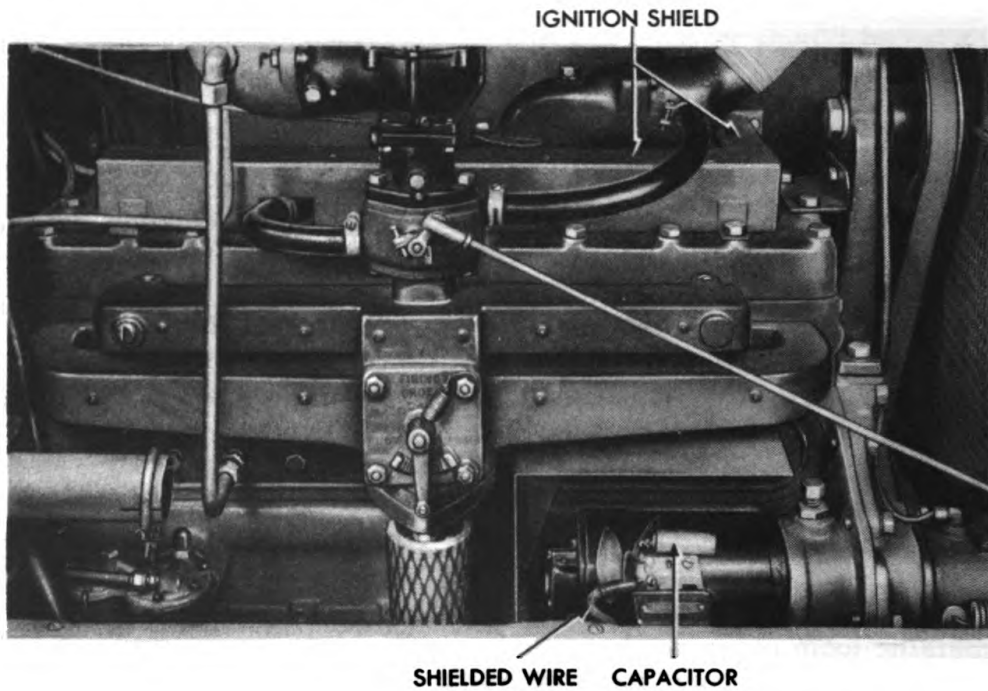
a. **General.** During operation, the generating unit is a source of radio interference. It broadcasts radio waves. This is objectionable because it interferes with reception on nearby wireless equipment. It also enables the enemy to determine the exact location of the unit with detecting instruments. To overcome this handicap, units bearing serial numbers 96 to 138 inclusive were equipped to suppress radio interference. This suppression system consists of ground connectors, ignition shield, capacitors, and suppressors. Each is described as to construction and function in its subparagraph, below. In addition, shielded wire is used for the battery charging generator circuit (fig. 201) and for the ignition primary circuit (fig. 204). This is conventional type electrical wire with a flexible metallic loom covering the insulation. The loom is grounded to the framework of the unit to arrest radio interference.

b. **Ground Connectors** (fig. 203). Six ground connectors are used. Each connector is a woven metal flexible strap with a flat lug soldered to each end. A nut, lock washer, and bolt connect one connector to voltage regulator, generator terminal box, or to one of the four corners of the instrument panel. The other end of each connector is similarly attached to the housing and framework of the unit. Thus the connectors provide continuity of circuit between the instrument panel (with instruments) and the rest of the unit.

c. **Shield** (figs. 201 and 202). A sheet metal housing completely encloses the engine ignition secondary circuit—distributor, coil, spark plugs, and all high-tension wires. This housing or shield is grounded to the engine and arrests radio interference from the ignition system. The shield is of simple construction. Its sheet metal components are attached to each other with screws, lock washers, and nuts. The entire shield is attached to the engine by means of brackets which fit under heads of cylinder head cap screws.

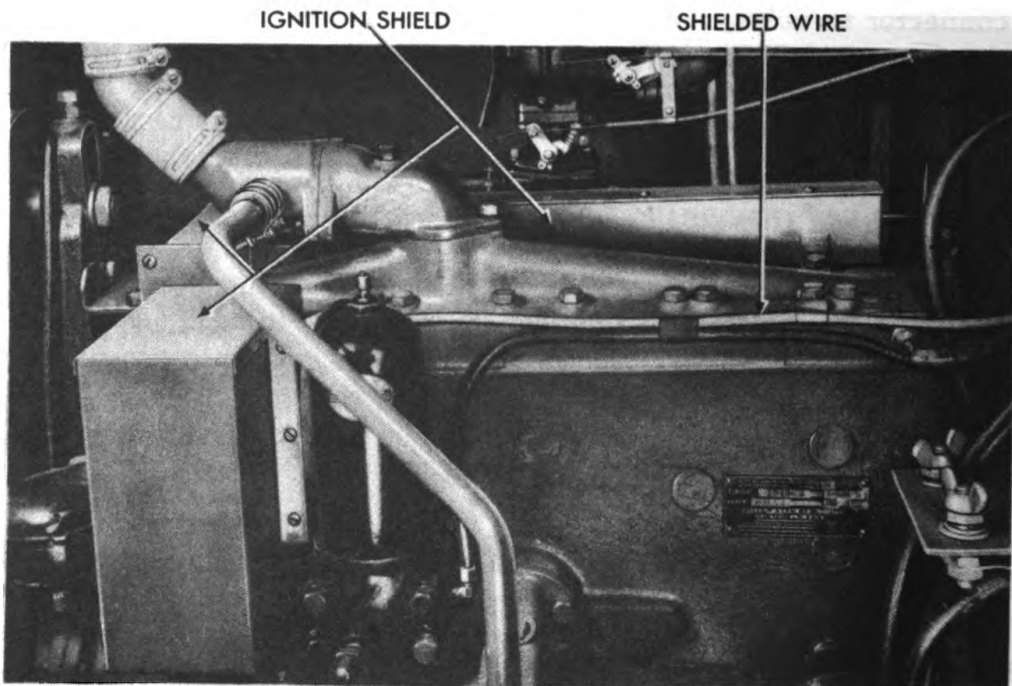
d. **Capacitors** (figs. 201 and 204). Eight capacitors or condensers are used in the radio noise suppression system. One is mounted on the battery charging generator. Its lead wire is connected to the "CG" terminal of the two-charge regulator. Another capacitor is mounted adjacent to the ignition coil. Its lead wire is attached to the coil "IGN" terminal. The six remaining capacitors are mounted on top of the load terminal box. Their leads are connected to terminal box terminals or bus bar leads "A," "B," "C," "O,"

ORDNANCE MAINTENANCE—GENERATING UNIT M18



RA PD 78577

Figure 201—Radio Noise Suppression Units Installed on Engine (1)



RA PD 78590

Figure 202—Radio Noise Suppression Units Installed on Engine (2)

RADIO INTERFERENCE SUPPRESSION

and to terminal block terminals "CG" and "IGN," respectively. Each capacitor consists of two sheets of metal foil separated by an insulating sheet, rolled, and enclosed in a small cylindrical metal case. One sheet of foil is grounded to the case. The other is connected to the capacitor lead wire. Thus one sheet of foil is connected to each side of its circuit. This close proximity, yet complete separation, of the two sides of the circuit has a tendency to condense or intensify the current. It smooths out fluctuations and causes the flow of current to stop the moment the circuit is opened. This stops arcing and consequent radio noise every time the circuit is broken.

e. Suppressors. Seven resistor type suppressors are used. One is inserted in spark plug circuit above each plug. The remaining suppressor is attached to the coil in the secondary circuit. Each suppressor is a resistor. Its function is to check "dribbling" of spark before and after voltage builds up to deliver the main arcing necessary in the ignition system. This cuts down on radio interference without sacrificing ignition efficiency.

123. GROUND CONNECTORS.

a. Removal (fig. 203). Remove nut, lock washer, and bolt which attaches each end connector to unit. Lift connector from unit.

b. Inspection and Repair. Examine connector, bolts, lock washers, and nuts to see if any are bent or broken. Replace broken parts. Buff off contact surfaces of connector and surfaces which it contacts on unit.

c. Installation (fig. 203). Position connector on unit and install the two bolts, lock washers, and nuts which attach connector to unit. Tighten nuts securely.

124. SHIELD.

a. Removal (figs. 201 and 202).

(1) Remove nuts, lock washers, and screws which attach distributor and coil cover to rest of shield. Lift cover from shield.

(2) Disconnect "IGN" wire and condenser lead wire from coil.

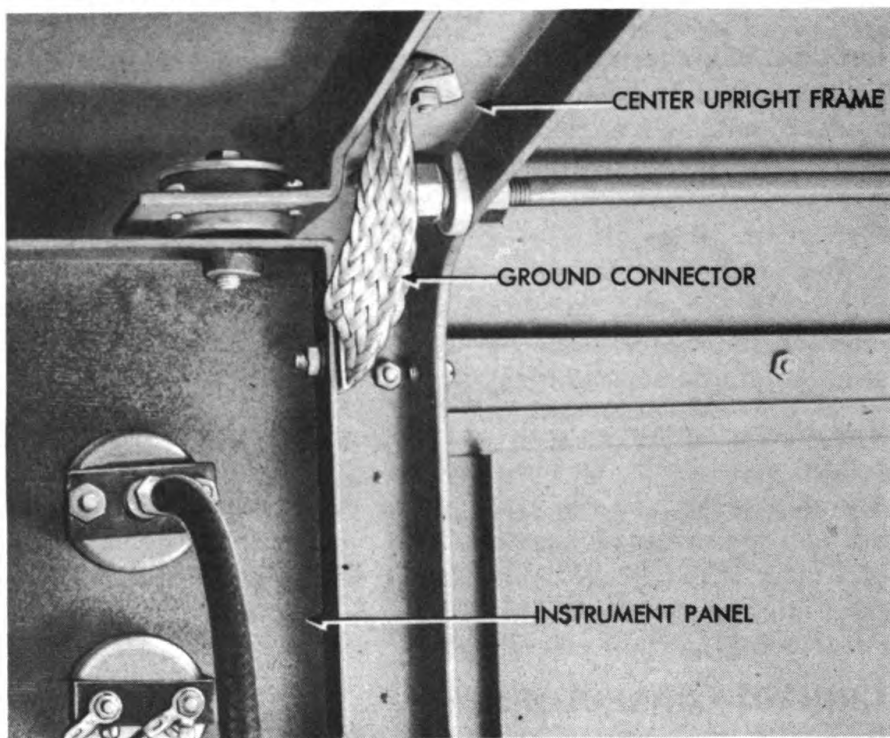
(3) Remove nuts, lock washers, and bolts which attach shield to coil bracket.

(4) Remove cylinder head cap screws which secure shield to engine. Lift shield from engine.

b. Disassembly (figs. 201 and 202). Remove nuts, lock washers, and screws which hold together sheet steel components of shield, and separate the parts.

c. Inspection and Repair.

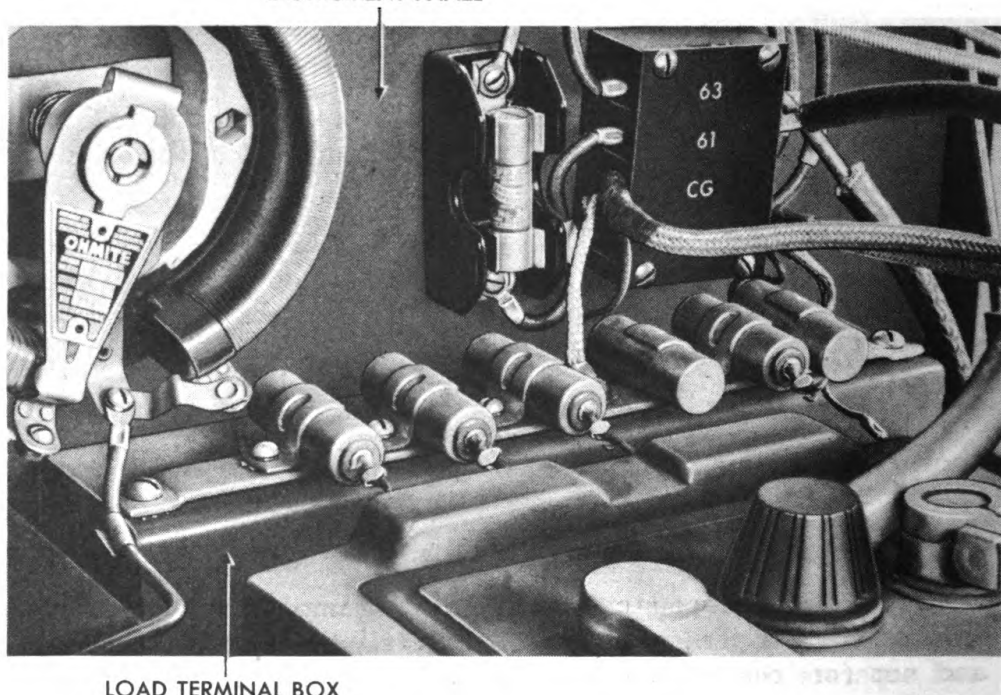
(1) Inspect sheet metal parts to see if they are bent or broken.



RA PD 78576

Figure 203—Ground Connector Installed

INSTRUMENT PANEL



RA PD 78594

Figure 204—Radio Noise Suppression Capacitors Installed

RADIO INTERFERENCE SUPPRESSION

Bump bent parts to original shape. Replace or weld broken parts.

(2) Inspect all screws, nuts, and lock washers. These must be in perfect condition to prevent loose assembly which would render shield useless. Replace damaged parts.

d. **Assembly** (figs. 201 and 202). Place parts in position and install screws, lock washers, and nuts. Tighten nuts securely. Do not install distributor and coil cover until after installation of shield on engine.

e. **Installation** (figs. 201 and 202).

(1) Place shield in position on engine. Be sure all wires of ignition secondary circuit are enclosed. Install cylinder head cap screws which attach shield to engine.

(2) Install bolts, lock washers, and screws which attach shield to coil bracket.

(3) Connect "IGN" wire and capacitor lead wire to "IGN" terminal of ignition coil.

(4) Position distributor and coil cover on shield. Install screws, lock washers, and nuts which attach cover to shield.

125. CAPACITORS.

a. **Removal** (figs. 201 and 204).

(1) Disconnect capacitor lead wire from terminal or bus bar to which it is attached.

(2) Remove nut, lock washer, and screw (or screw and lock washer) which attach capacitor. Lift capacitor from unit.

b. **Inspection and Repair.**

(1) A short-circuited or ground capacitor will render inoperative the circuit to which it is connected. Disconnect lead and touch probes of test lamp to lead and to body of capacitor. If lamp lights, capacitor is shorted and must be replaced.

(2) Test for an open circuit by replacing capacitor with one known to function properly. If radio interference disappears, an opening in the original capacitor is indicated.

c. **Installation** (figs. 201 and 204).

(1) Position capacitor on generator terminal box, generator, or ignition coil, as the case may be. Install the screw, lock washer, and nut (or lock washer and screw) which attach capacitor.

(2) Connect capacitor lead wire to terminal or bus bar from which it was disconnected at time of removal.

ORDNANCE MAINTENANCE—GENERATING UNIT M18**126. SUPPRESSORS.****a. Removal.**

(1) Remove nuts, lock washers, and screws which attach distributor and coil cover and spark plug cover to rest of shield. Lift covers from shield.

(2) Pull suppressors from spark plugs and ignition coil. Twist suppressors from ignition wires.

b. Inspection and Repair.

(1) Inspect suppressors to see if they are broken or if their terminals are corroded. Buff off corrosion. Replace broken suppressors.

(2) Test operation of suppressors by substituting them, one at a time, in the ignition circuit of an engine running without radio interference. Continued noninterference and otherwise satisfactory operation of the engine indicates suppressor is functioning properly. Replace suppressors whose functioning is unsatisfactory or questionable.

c. Installation.

(1) Insert ignition wires into ends of suppressor, and screw suppressor clockwise until tight. Push other end of suppressor onto its spark plug or into tower of ignition coil, as the case may be. Similarly install remaining suppressors. Be sure all suppressor connections are tight.

(2) Position spark plug cover and distributor and coil cover on shield. Install the screws, lock washers, and nuts which attach covers to shield.

ORDNANCE MAINTENANCE—GENERATING UNIT M18

RA PD 78536

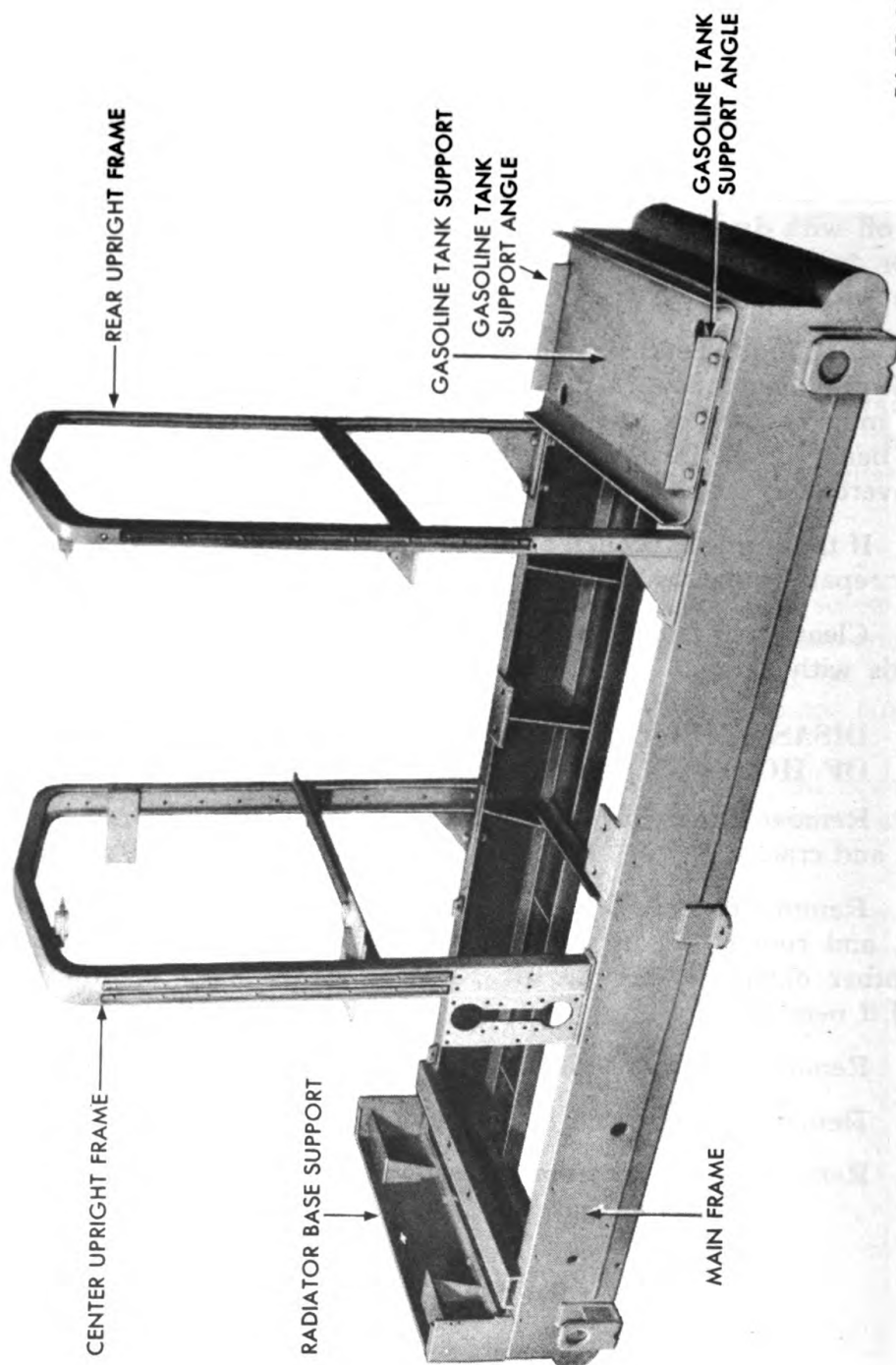


Figure 205—Frame Assembled

FRAME AND HOUSING

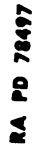


Figure 206—Main Frame Scale Drawing

ORDNANCE MAINTENANCE—GENERATING UNIT M18

CHAPTER 9

REFERENCES

129. PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes or revisions of references given in this chapter and for new publications relating to materiel covered in this manual:

- a. Index (index to SNL's)..... ASF Cat.
ORD 2 OPSI
- b. Index to Ordnance Publications (listing FM's, TM's, TC's, and TB's of interest to ordnance personnel, OPSR, FSMWO's, BSD, S of SR's, OSSC's and OFSB's. Including alphabetical listing of ordnance major items with publications pertaining thereto)..... OFSB 1-1
- c. List of Publications for Training (listing MR's, MTP's, FM's, TM's, TR's, TB's, MWO's, SB's, WDLO's and FT's)..... FM 21-6
- d. List of Training Films, Film Strips and Film Bulletins (listing TF's, FS's, and FB's by serial number and subject)..... FM 21-7
- e. Military Training Aids (listing graphic training aids, models, devices, and displays)..... FM 21-8

130. STANDARD NOMENCLATURE LISTS.

- a. Cleaning, preserving and lubricating materials; recoil fluids, special oils, and miscellaneous related items..... ORD 5
SNL K-1
- b. Harbor defense, railway and antiaircraft artillery sighting equipment and fire control instruments SNL F-2
- c. Major items of antiaircraft artillery..... SNL D-2
- d. Tools, maintenance, for repair of automotive and semi-automatic vehicles..... ORD 6
SNL G-27
- e. Tool-sets for maintenance of sighting and fire control equipment..... SNL F-272

REFERENCES

f. System, cable, M1	SNL F-207
g. System, cable, M3, M10	SNL F-244
h. Unit, generating, M18	SNL F-291

131. EXPLANATORY PUBLICATIONS.

a. Automotive Materiel.

Antiaircraft cable system and repair kits, all types and voltage controller M1	TM 9-649
Automotive electricity	TM 10-580
Automotive lubrication	TM 10-540
Chassis, body, and trailer units	TM 10-560
Fuels and carburetion	TM 10-550
Generator trailer M7 (to be superseded by TM 9-1881, when published)	TM 9-881
Generating unit M18	TM 9-617
Internal combustion engine, The	TM 10-570
Machinist, The	TM 10-445
Military motor vehicles	AR 850-15
Motor transport	FM 25-10
Motor transport inspections	TM 10-545
Ordnance storage and shipment chart-group F	OSSC-F
Sheet metal work, body, fender, and radiator repairs ...	TM 10-450
Storage of motor vehicle equipment	AR 850-18

b. Fire Control.

Instruction guide: Instrument repairman	TM 9-2602
Ordnance maintenance: Director M7, M7A1B1, M7A1B2	TM 9-1658
Ordnance maintenance: Directors M9 and M10, gen- eral maintenance; and computers M3 and M4	TM 9-1671A
Ordnance maintenance: Directors M9 and M10, power unit M8, tracker M2, and altitude converter M2	TM 9-1671B
Ordnance maintenance: Directors M9 and M10, wir- ing diagrams	TM 9-1671C
Ordnance maintenance: Director M9A2, wiring dia- grams	TM 9-1671D
Ordnance maintenance: Electrical testing apparatus for fire control equipment	TM 9-1672

ORDNANCE MAINTENANCE—GENERATING UNIT M18

Ordnance maintenance: Height finder M1.....	TM 9-1623
Ordnance maintenance: Height finder M2.....	TM 9-1624
Ordnance maintenance: Remote control system M2....	TM 9-1642

c. Gun Materiel.

90-mm antiaircraft gun materiel M1 and M1A1.....	TM 9-370
90-mm gun M1 and 90-mm antiaircraft gun mount T2E1	TM 9-371
120-mm gun M1 and 120-mm antiaircraft gun mount M1	TM 9-380

d. Maintenance.

Artillery lubrication, general.....	OFSB 6-4
Cleaning, preserving, sealing, lubricating, and related materials issued for ordnance materiel.....	TM 9-850

e. Miscellaneous.

Basic maintenance manual.....	TM 38-250
Decontamination	TM 3-220
Defense against chemical attack.....	FM 21-40
Hand, measuring, and power tools.....	TM 10-590
Instruction guide: Welding—theory and application..	TM 9-2852

INDEX

A	Page	C	Page
Accessories		Camshaft	
inspection	6	description	37
installation	202	end play	19
removal	161	inspection	179
Air cleaner		installation	
assembly	62	camshaft	198
description	56	gear	190
disassembly	61	removal of gear	175
inspection and repair	62	repair	186
maintenance	14	specifications	40
specifications	41	Capacitors, radio interference	
Air leaks	18, 19	suppression	303, 307
Ammeters		Carburetor	
description	263, 268	air leaks	18
inspection and repair	263, 269	assembly	71
trouble shooting	23	description	56
Armature		disassembly	68
inspection	115, 152	gasoline leaks	21
repair	152	inspection and repair	69
B		maintenance	14
Batteries		specifications	40
battery test	13	Circuit breaker panel	
inspection	7	assembly	278, 279, 281
trouble shooting	23	Cleaning the engine	45
Bearings, main, repair	189	Commutator, inspection and repair	152
Bell housing		Commutator end head	
inspection	182	assembly	124
installation	198	disassembly	114
Bendix drive assembly	149	inspection and repair	154
Box, voltage regulator, installation	299	Connecting rods	
Brake receptacle, electric		alignment	189
assembly and installation	132	description	37
description	113, 129	installation	200
inspection and repair	132	specifications	40
removal and disassembly	131	(See also Piston and connecting rod assembly)	
Brush holder assembly		Connectors (ground), radio interference suppression	303, 305
assembly	239	Coolant	
disassembly	220	coolant service	46
(See also Exciter field and brush holder support bracket)		insufficient coolant	20
Brushes, commutator, excessive sparking at	33	Cooling system	
		description and construction	42
		inspection	6
		maintenance	15
		trouble shooting	20

ORDNANCE MAINTENANCE—GENERATING UNIT M18

C—Contd.	Page		Page
Crankcase ventilation	100	installation	
Cranking jaw, installation	199	engine	202
Crankshaft		front support	199
inspection	181	leaks	46
installation	196	maintenance	15, 45, 46
repair	189	removal	159
specifications	40	repair	183
Cylinder block		specifications	40
inspection	176	tests and adjustments	204
repair	183	trouble shooting	17
Cylinder head		tune-up	11
inspection	175	valve timing	198
installation	201	Engine and generator assembly	
repair	183	installation	203
specifications	40	removal	159
trouble shooting	19	Exciter field and brush holder	
Cylinders, engine, description	37	support bracket	
		assembly	245
		disassembly	220
		inspection	223
		installation	245
		removal	213
		repair	228
		Exciter field rheostat (See	
		Rheostat, exciter field)	
		Exhaust system	
		description	91
		inspection	9
		trouble shooting	22
		F	
		Fans	
		assembly	53, 239
		description	44
		disassembly	
		fan assembly	221
		fans	51
		inspection and repair	
		fan drive pulley	181
		fans	53
		installation	245
		removal	213
		specifications	41
		Filter (See Oil filter)	
		Flushing the engine	45

D

Distributor	
assembly	142
defective distributor	26
description	133
disassembly	138
inspection and repair	140
installation	147
maintenance	13
removal	135
specifications	42, 147
tests and adjustments	146
timing	148
Drive assembly, Bendix	149

E

Engine	
assembly	190
characteristics and data	1
cleaning of components	175
compression	11
compression (low)	18
data	205, 206
description	37
disassembly	165
inspection	6, 175

INDEX

F—Contd.	Page		Page
Flywheel		noisy generator	25, 36
inspection	182	removal (a-c generator)	212
installation	196	repair	
loose wheel	19	a-c generator	228
repair	189	battery-charging generator	118
Frame	309	specifications	41, 207
Fuel lines		trouble shooting	23, 28, 33
clogged lines	20	(See also Engine and generator assembly)	
description	61	Governor	
inspection and repair	90	adjustment	80
specifications	42	assembly	82
Fuel pump (See Pump, fuel)		description	56
Fuel system		disassembly	77
description	56	incorrect setting	18
excessive consumption of fuel	21	inspection and repair	80
inoperative system	17	specifications	42
inspection	8		
trouble shooting	20	H	
water in fuel	18		
Fuse blocks	286	Hoses, dimensions of	44
		Housing and stator assembly	
G		assembly	233
Gear cover		disassembly	222, 309
assembly	190	inspection	227
disassembly	174	repair	233, 309
inspection	182	Hydrostatic lock (engine)	17
Generating system			
adjustment (a-c generator)	249	I	
assembly			
a-c generator	233	Idler gear	
battery-charging generator	118	installation on shaft	190
characteristics and data	1	removal from shaft	175
description		Idler shaft	
a-c generator	207	description	37
generating circuit	109	inspection	182
disassembly		Ignition system	
a-c generator	213	description	133
battery-charging generator	114	inoperative system	17
inoperative generator	23	inspection	7
inspection		preignition	18
a-c generator	9, 222	radio interference suppression	36
battery-charging generator	7, 115	specifications of coil	42
generating system	9	test (coil)	135
generating unit M18	5, 6	timing	14
installation (a-c generator)	248	trouble shooting	25
maintenance	11		

ORDNANCE MAINTENANCE—GENERATING UNIT M18

I—Contd.	Page		Page
Instrument panel		Oil filter	
description and construction	259	assembly	101
inspection	10, 261	description	100
installation and assembly	261	inspection and repair	101
removal and disassembly	259	installation	102
repair	261	removal and disassembly	100
trouble shooting	27	specifications	42
L		Oil pan	
Lamp, test	28	assembly	196
Leaks, air	18, 19	disassembly	174
Lighting system, trouble shooting	27	inspection	182
Lubrication system, engine		installation	200
description	98	repair	189
inspection	9	Oil pipe, installation	200
trouble shooting	22	Oil strainer	
M		assembly and installation	106
Manifolds, intake and exhaust		clogged strainer	23
air leaks	18, 19	description	100
description	37, 91	inspection and repair	105
disassembly and assembly	93	maintenance	15
inspection and repair	93	removal and disassembly	105
Meters (time and frequency)		specifications	42
description		Overload switch	276
meters	263	P	
switch	269	Pinion housing, inspection and	
disassembly and assembly of		repair	154
switch	273	Pipe, exhaust	
inspection and repair		description	93
frequency meter	268	inspection and repair	98
switch	273	Piston and connecting rod assembly	
time meter	263	assembly	190
installation of switch	274	disassembly	174
removal of switch	269	inspection	180
Misfires, engine	18	repair	186
Muffler		Pistons	
description	93	description	37
disassembly and assembly	98	fitting	
inspection and repair	98	pins	187
O		pistons	189
Oil, low or no pressure	22	rings	186
Oil filler pipe adapter, installation	202	specifications	40
		Pressure gage, oil	
		description, inspection, and	
		repair	262
		inoperative gage	22

INDEX

P—Contd.	Page		Page
Pump, fuel		trouble shooting	36
description	61	Receptacles, power	
disassembly and inspection	83	assembly and installation	256
gasoline leaks	21	description	
inoperative pump	20	30-ampere	254
low pressure	21	200-ampere	250
maintenance	14	125-volt	284
repair and assembly	85	disassembly	
specifications	42	30-ampere	254
Pump, oil		200-ampere	252
assembly	107, 190	inspection and repair	
description	100	30-ampere	256
disassembly	107	200-ampere	252
inspection and repair	107	125-volt	285
installation	109, 200	power receptacles	10
removal	106	removal	
specifications	42	30-ampere	254
worn gears	23	200-ampere	250
Pump, water		Regulator, two-charge	
assembly		assembly and installation	129
pump	55	description	109
pump drive	196	inspection and repair	7, 125
description		radio interference suppression	36
pump	44	removal and disassembly	125
pump drive	37	specifications	41
disassembly		Regulator, voltage	
pump	53	adjustments	300
pump drive	173	assembly	297
inoperative pump	20	description	287
inspection and repair		disassembly	291
pump	55	inspection and repair	
pump drive	180	regulators	7, 293
installation of drive	202	switches	296, 297
specifications	41	installation	
R		regulators	298, 299
Radiator		switches	297, 298
assembly	49	malfunctions	33
description	43	radio interference suppression	36
inspection	48	removal	289
installation	51	Reports and records	5, 6
removal and disassembly	48	Resistors	296, 298
repair	49	Rheostat, exciter field	274, 276
Radio interference suppression		Rheostat, lamp dimmer	282
system		Rheostats, voltage regulator	296, 298
description	303		
installation of voltage regulator	297		

R—Contd.	Page		Page
Rotor assembly		Terminal blocks	285
assembly	239	Terminal box, load	10, 256, 258
disassembly	221	Throttle body	
inspection	226	assembly	77
installation	245	description	56
removal	218	disassembly	74
repair	231	inspection and repair	75
		throttle does not open	21
		specifications	41
S		Toggle switches	274
Shield, radio interference		Tools, special	6
suppression		Transformer	296, 299
assembly and installation	307	Tube, exhaust	
description	303	assembly	98
inspection and repair	305	description	91
removal and disassembly	305	disassembly	96
Short circuits	23	inspection and repair	96
Sockets, lamp and trouble light	284	Tune-up, engine	11
Spark plugs			
description	133	V	
inspection and repair	149	Vacuum test	12
maintenance	12	Valve guides, repair	184
specifications	41	Valve operating mechanism, repair	185
Starting motors		Valve seats, repair	184, 186
assembly	155	Valve tappets	
disassembly	151	adjustment	14, 201
inoperative motors	26	assembly of cluster	196
inspection and repair	7, 152	disassembly of cluster	174
specifications	41	inspection	179
trouble shooting	26	installation of cluster	200
Stator assembly (See Housing and		loose tappets	19
stator assembly)		repair	186
Strainer (See Oil strainer)		Valves	
Suppressors, radio interference	305, 308	description	37
Switches (See Meters (time and		inspection	179
frequency); Overload		installation	200
switch; Toggle switches;		repair	185
and Regulator, voltage)		Voltage regulator (See Regulator,	
		voltage)	
T		Voltmeter	268
Tank, gasoline			
assembly and installation	90	W	
description	61	Wrench tensions	206
inspection and repair	89		
removal and disassembly	87		
Temperature gage, engine	263		

ORDNANCE MAINTENANCE—GENERATING UNIT M18

I—Contd.	Page		Page
Instrument panel		Oil filter	
description and construction . . .	259	assembly	101
inspection	10, 261	description	100
installation and assembly	261	inspection and repair	101
removal and disassembly	259	installation	102
repair	261	removal and disassembly	100
trouble shooting	27	specifications	42
		Oil pan	
L		assembly	196
Lamp, test	28	disassembly	174
Leaks, air	18, 19	inspection	182
Lighting system, trouble shooting	27	installation	200
Lubrication system, engine		repair	189
description	98	Oil pipe, installation	200
inspection	9	Oil strainer	
trouble shooting	22	assembly and installation	106
		clogged strainer	23
M		description	100
Manifolds, intake and exhaust		inspection and repair	105
air leaks	18, 19	maintenance	15
description	37, 91	removal and disassembly	105
disassembly and assembly	93	specifications	42
inspection and repair	93	Overload switch	276
Meters (time and frequency)			
description		P	
meters	263	Pinion housing, inspection and	
switch	269	repair	154
disassembly and assembly of		Pipe, exhaust	
switch	273	description	93
inspection and repair		inspection and repair	98
frequency meter	268	Piston and connecting rod assembly	
switch	273	assembly	190
time meter	263	disassembly	174
installation of switch	274	inspection	180
removal of switch	269	repair	186
Misfires, engine	18	Pistons	
Muffler		description	37
description	93	fitting	
disassembly and assembly	98	pins	187
inspection and repair	98	pistons	189
		rings	186
O		specifications	40
Oil, low or no pressure	22	Pressure gage, oil	
Oil filler pipe adapter, installation	202	description, inspection, and	
		repair	262
		inoperative gage	22

INDEX

P—Contd.	Page		Page
Pump, fuel		trouble shooting	36
description	61	Receptacles, power	
disassembly and inspection	83	assembly and installation	256
gasoline leaks	21	description	
inoperative pump	20	30-ampere	254
low pressure	21	200-ampere	250
maintenance	14	125-volt	284
repair and assembly	85	disassembly	
specifications	42	30-ampere	254
Pump, oil		200-ampere	252
assembly	107, 190	inspection and repair	
description	100	30-ampere	256
disassembly	107	200-ampere	252
inspection and repair	107	125-volt	285
installation	109, 200	power receptacles	10
removal	106	removal	
specifications	42	30-ampere	254
worn gears	23	200-ampere	250
Pump, water		Regulator, two-charge	
assembly		assembly and installation	129
pump	55	description	109
pump drive	196	inspection and repair	7, 125
description		radio interference suppression . .	36
pump	44	removal and disassembly	125
pump drive	37	specifications	41
disassembly		Regulator, voltage	
pump	53	adjustments	300
pump drive	173	assembly	297
inoperative pump	20	description	287
inspection and repair		disassembly	291
pump	55	inspection and repair	
pump drive	180	regulators	7, 293
installation of drive	202	switches	296, 297
specifications	41	installation	
R		regulators	298, 299
Radiator		switches	297, 298
assembly	49	malfunctions	33
description	43	radio interference suppression . .	36
inspection	48	removal	289
installation	51	Reports and records	5, 6
removal and disassembly	48	Resistors	296, 298
repair	49	Rheostat, exciter field	274, 276
Radio interference suppression		Rheostat, lamp dimmer	282
system		Rheostats, voltage regulator . .	296, 298
description	303		
installation of voltage regulator	297		

ORDNANCE MAINTENANCE—GENERATING UNIT M18

R—Contd.	Page		Page
Rotor assembly		Terminal blocks	285
assembly	239	Terminal box, load	10, 256, 258
disassembly	221	Throttle body	
inspection	226	assembly	77
installation	245	description	56
removal	218	disassembly	74
repair	231	inspection and repair	75
		throttle does not open	21
		specifications	41
S		Toggle switches	274
Shield, radio interference		Tools, special	6
suppression		Transformer	296, 299
assembly and installation	307	Tube, exhaust	
description	303	assembly	98
inspection and repair	305	description	91
removal and disassembly	305	disassembly	96
Short circuits	23	inspection and repair	96
Sockets, lamp and trouble light	284	Tune-up, engine	11
Spark plugs			
description	133	V	
inspection and repair	149	Vacuum test	12
maintenance	12	Valve guides, repair	184
specifications	41	Valve operating mechanism, repair	185
Starting motors		Valve seats, repair	184, 186
assembly	155	Valve tappets	
disassembly	151	adjustment	14, 201
inoperative motors	26	assembly of cluster	196
inspection and repair	7, 152	disassembly of cluster	174
specifications	41	inspection	179
trouble shooting	26	installation of cluster	200
Stator assembly (See Housing and		loose tappets	19
stator assembly)		repair	186
Strainer (See Oil strainer)		Valves	
Suppressors, radio interference	305, 308	description	37
Switches (See Meters (time and		inspection	179
frequency); Overload		installation	200
switch; Toggle switches;		repair	185
and Regulator, voltage)		Voltage regulator (See Regulator,	
T		voltage)	
Tank, gasoline		Voltmeter	268
assembly and installation	90		
description	61	W	
inspection and repair	89	Wrench tensions	206
removal and disassembly	87		
Temperature gage, engine	263		

